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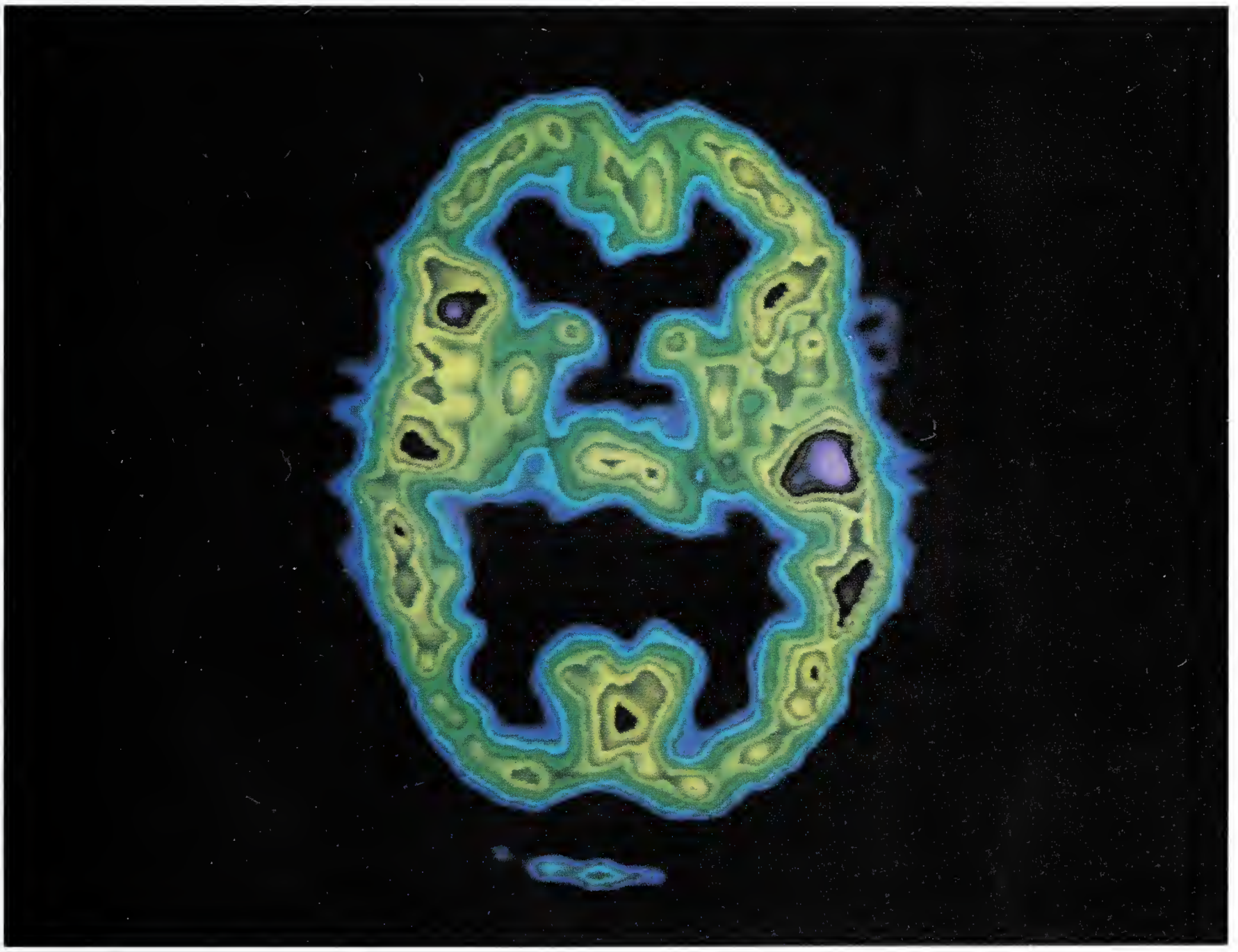

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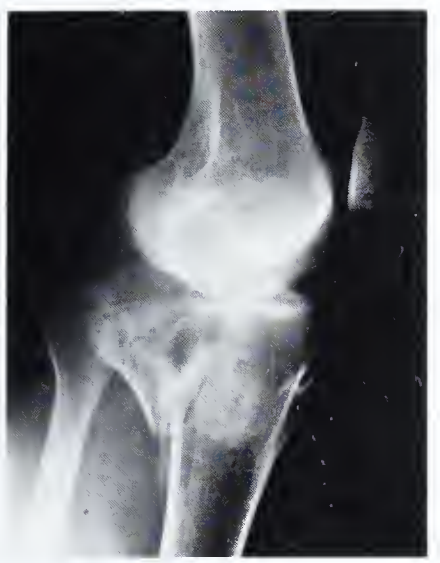
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Cover photo: (Figure 6a) PET scan through the thalamus and striatum after injection of [18F]fluoro-deoxyglucose. Pink represents high levels of glucose consumption while yellow to blue represents decreasing levels of glucose consumption. The pink area in the left insula is due to activation of the primary auditory cortex. For more information, see "Computers and Medical Imaging". (Photographs courtesy of Dr. E.S. Garnett, Department of Nuclear Medicine, McMaster University Medical Centre, Hamilton)

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Editorial

Nowhere has the technological revolution made more of an impact in medical care, than in the field of Diagnostic Medical Imaging. With recent developments in micro-processor electronics and software algorithms, the design of new imaging equipment has become part of a multi-billion dollar industry on the cutting edge of technology. The development of new generations of three dimensional CT scanners, color doppler ultrasounds, and MRI machines provide us with a breathtaking view through the window on the world of health and disease. In this edition's illustrated feature article, Lisa Thain and Peter Wan examine the state of the art and science in imaging modalities. For the first time in the 64 year history of the University, we present some of the illustrations in full color.

A publication of the Association of Americal Medical Colleges entitled, "Physicians for the Twenty-First Century — Report of the Panel on the General Professional Education of the Physician and College Preparation for Medicine", contains observations, new ideas, and strategies to improve the effectiveness of instructional programs for the promotion of learning and personal development of each medical student. Beginning with this edition of the journal, we would like to initiate a continuing forum and dialogue on Medical Education. We invite clinicians as well as students to share their ideas and experiences. In this edition, we present an article entitled "Thoughts on Medical Education" by Dr. Esses.

The University of Toronto Medical Society and the Medical Journal would like to thank Apple Computer Inc., for the generous donation of a Macintosh Desktop Publishing System. It is one giant step forward from using an electric typewriter. We would also like to thank Dr. Eva Swenson, Office of the Vice-President, Research, University of Toronto, for making it all possible.

We hope you enjoy this edition of the journal as much as we did preparing it. We wish to thank all those who helped in the preparation and production.

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Tissue Expansion in Burn Reconstruction

*Dimitri J. Anastakis 8T8, Peter C. Nelligan, M.B., F.R.C.S.(I), Walter J. Peters, Ph.D., M.D., F.R.C.S.(C)**

Abstract

Adjacent normal skin is ideal donor tissue for reconstruction of deformities resulting from burn injury. Tissue expansion increases the amount of available donor tissue and the safety with which it can be transferred. The use of tissue expansion is described in 12 selected patients undergoing burn reconstruction at the Ross Tilley Burn Centre. A total of 40 tissue expanders were inserted. There were complications in 8 of the 40 expanders inserted - 11 of the 12 cases were managed successfully by this technique. The post-operative results were aesthetically far superior to those of available alternative techniques. With its limitations and potential complications in mind, the use of tissue expansion has become a preferred technique for burn reconstruction in selected patients at the Ross Tilley Burn Centre.

Introduction

Tissue has the potential to expand. Tissue expansion occurs normally during pregnancy, secondarily in obesity, and abnormally over enlarging tumor masses. Many ancient cultures made use of this potential by serially expanding ears, lips, necks and other body parts for "aesthetic" or decorative purposes[1 2 3].

In 1957, Neumann[4] was the first to use an inflatable device to attempt to expand soft-tissue for reconstruction of microtia. Two decades later Radovan[5 6 7 8] pioneered what is now modern tissue expansion. Like Radovan's implants, modern expanders are gradually filled by percutaneous injection via an injection port that is attached directly to the inflatable device. Lapin *et al*[9] modified the technique by incorporating the reservoir for injection into the prosthesis itself. Austad and Rose[10] developed a "self-inflating" expander by including a high solute load inside a permeable envelope.

Although most initial efforts were designed to aid in reconstructing the breast after mastectomy, the potential applications of this technique to other areas of the body were apparent to reconstructive surgeons. Tissue expanders are now available in a wide variety of sizes and shapes, and the applications seem limited only by the imagination of the plastic surgeon.

The application of tissue expansion techniques in burn reconstruction has gained increasing popularity and acceptance[11 12]. The main objectives of burn reconstruction include the release of scar contractures and the possible replacement of scarred tissue with donor skin of similar color and character. The most evident problem in burn reconstruction is the limited availability of such ideal donor tissue. The post-burn patient poses a challenging and unique problem during reconstruction.

The alternative techniques available for reconstruction include direct closure (small wounds), serial excision, skin grafts (split and full-thickness), regional, distant and free flaps. The indications, limitations and drawbacks of these alternative techniques are briefly outlined in Table 1.

Tissue Expansion

Burn scars that are ideal for tissue expansion are those with normal, unscarred adjacent skin. This technique produces expanded skin flaps — which allow for the advancement of normal skin into areas for scarred tissue; and expanding tissue adjacent to flaps — allowing for primary closure of donor site. Further, studies indicate that expanding the tissue also increases its vascularity, much like a "delay" phenomenon[13 14 15]. Therefore, not only is more tissue available, but the safety with which it can be transferred is also increased.

The key to success is planning, with particular attention given to minimizing potential problems. The incisions for insertion of the expander should be radial to the perimeter around the tissue to be expanded. Ideally, the incisions should not overlie expanded tissue and little or no tension should be applied across the wound by the expansion.

Determining the amount or extent of expansion is perhaps the most difficult decision. For safe planning, the amount of expanded tissue should measure at least three times the area of the potential defect. Anything less may result in an insufficient amount of tissue.

**Medical Director, Ross Tilley Burn Centre*
Assistant Professor, Division of Plastic Surgery
Wellesley Hospital

Table 1: Alternative Techniques in Burn Reconstruction

Technique	Indications	Limitations and Drawbacks
1. DIRECT CLOSURE	— small areas of burn scar	— limited by size of scar and potential distortion of adjacent mobile structure
2. SERIAL EXCISION	— moderate size scars particularly of the scalp	— multiple stages — tendency to form wide scars — limited by size of scar
3. SKIN GRAFTS i. split thickness ii. full thickness	— acute coverage of burn wound — facial aesthetic units eg. entire eyelids entire upper lip	— poor aesthetic quality especially if meshed — patchwork appearance — motility, expression and other qualities of normalcy rarely achieved
4. FLAPS i regional ii distant iii. free	— in situations where skin grafts will not suffice — unsuitable bed for graft take — eg. exposed bone or tendon — coverage of vital structures eg. exposed blood vessels or nerves	— donor site deformity — poor color match — inappropriate color match — limited application in facial construction due to lack of contour and re-animation potential

Computer programs are now available to determine the volume of expansion needed to close a given defect[16].

The expanded donor skin can be transferred as an advancement, rotation, or transposition flap. Ideally, transfer of the donor skin flap should result in minimal scarring. Direct advancement is associated with the least amount of scarring and donor site morbidity. Therefore it is the preferred method of flap transfer.

Tissue expansion has all the potential advantages of a regional flap and preserves donor site characteristics with minimal donor site morbidity. Obvious disadvantages include the need for at least two operative procedures, multiple office visits, and associated potential complications (see below).

Results

The major complications of soft-tissue expansion pose a serious threat to the operative procedure and can ultimately lead to implant failure. The incidence of each complication in this series is listed in Table 2.

Of the 40 tissue expanders inserted, only 2 expanders resulted in implant failure. In the other 38 cases, expanded tissue was successfully advanced and rotated to close the intended defect.

Infection occurred in 6 of the 40 tissue expanders inserted (Table 2). Infection in 4 of the 6 was secondary to expander exposure. Two of these 4 ended in implant failure with subsequent expander removal. The remaining two were treated with antibiotics (Cloxacillin) and continued with expansion until the reconstruction was successfully completed.

These case reports are presented to illustrate the applications of tissue expansion in burn reconstruction.

Table 2:
Complications of Tissue Expansion

1) Infection	[6/40]
2) Expander exposure	[7/40]
i) dehiscene of incision	[4/40]
ii) erosion of envelope fold through skin	[2/40]
iii) port exposure	[1/40]
4) Hematoma	[1/40]
5) Nerve compression	[1/40]
6) Implant failure	[2/40]

Figure 1a: Extensive keloid scarring can be seen in the regions of the lower forehead, glabellar and paranasal areas.

Figure 1b: All three tissue expanders fully inflated at 3 weeks after insertion. Note the exposed expander in the forehead area.

Case 1

C.W. is a 46 year old black male who — 3 years ago — sustained a flame burn injury to his hands and face on Christmas day. He was initially treated by excision and grafting to both hands. His face was not grafted. He presented with severe burn scar contractures of both hands and keloid scarring of his face (Figure 1a). Facial reconstruction was achieved by the use of tissue expanders. Tissue expanders were inserted into both cheeks and the forehead area and were inflated over a course of 3 weeks at which time the forehead expander became exposed (Figure 1b). Keloid scars in the region of the lower forehead, glabellar and paranasal area were excised and the subsequent defect closed by direct advancement and rotation of expanded skin flaps. Post-operatively further excess scar formation was prevented with the use of a rigid face mask and Jobst compression for a full 18-24 months. At 9 months, the aesthetic results were excellent (Figure 1c).

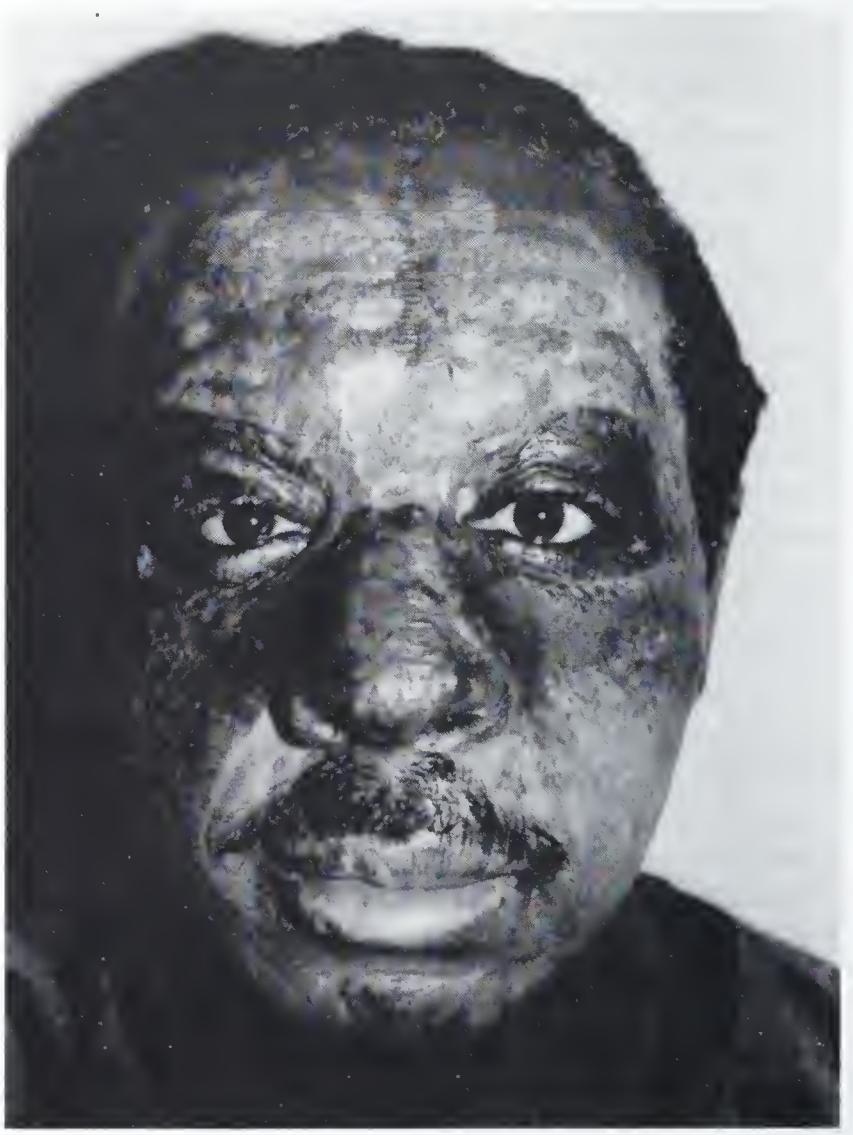

Figure 1c: At 9 months post-op, the aesthetic results were excellent.

Figure 2a: Note the extensive contour deformity, the result of a fourth degree burn.

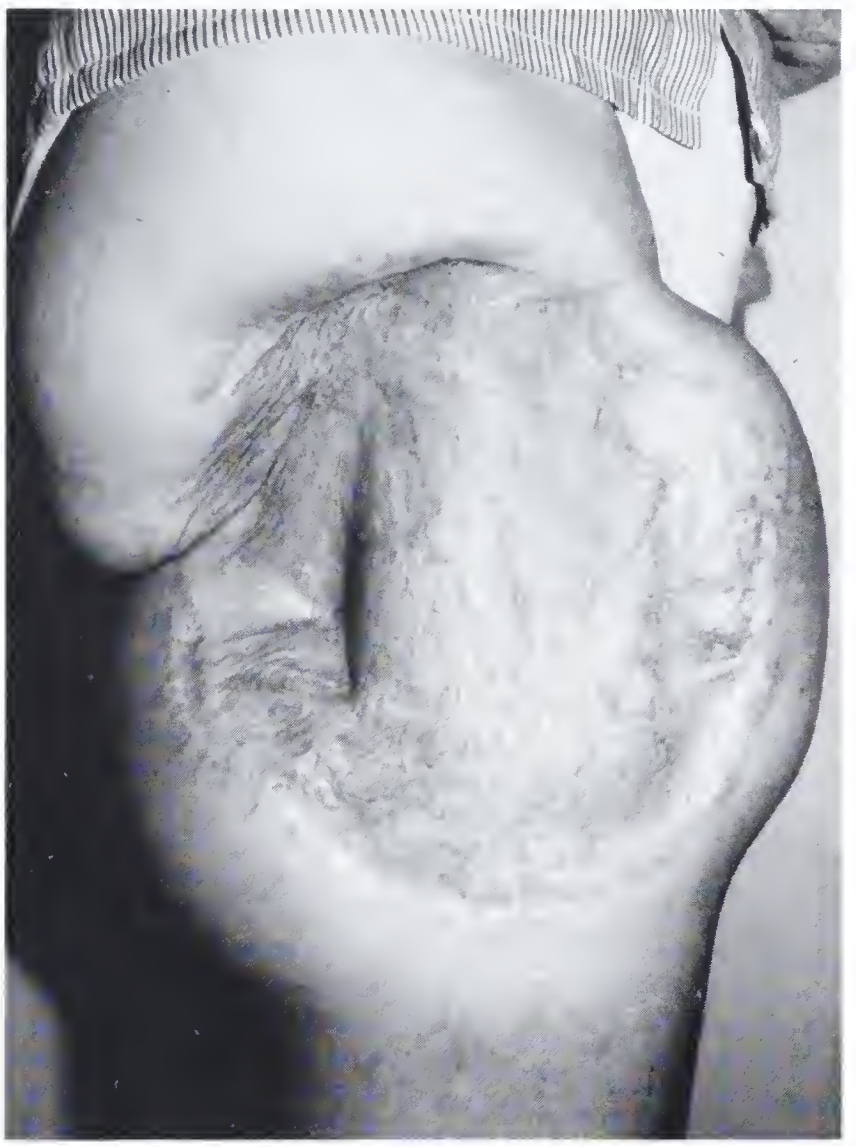

Figure 2b: Three tissue expanders were inserted around the margins of the defect and were inflated over a 6 week period.

Case 2

M.J. is a 36 year old female who sustained a full-thickness thermal contact burn to the right thigh in 1976. The injury occurred after coming in contact with a hot muffler. The burn was fourth degree extending down to the periostium of the greater trochanter. The resulting contour deformity was a source of concern to the patient (Figure 2a). Three tissue expanders were inserted around the margins of the defect and were inflated over a course of 6 weeks (Figure 2b). At the end of this time the wound area was excised and covered primarily by direct advancement of expanded tissue flaps. A satisfactory cosmetic result was achieved (Figure 2c).

Figure 2c: Post operatively, the contour deformity was corrected and the cosmetic results were satisfactory.

Figure 3a: An area of burn alopecia on the left side of the scalp was of concern to the patient.

Case 3

D.S. is a 36 year old female who was involved in a motor vehicle accident in 1983, sustaining severe flame burns to the head and neck, face and hands. Multiple procedures were performed in attempt to reconstruct the hands and face. Of concern to the patient was an area of burn alopecia on the left side of the scalp (Figure 3a). Tissue expanders were inserted on either side of the defect and inflated over a period of 8 weeks. At the end of that time the area of burn alopecia was totally excised and closed primarily by direct advancement of expanded skin flaps. The post-operative cosmetic appearance was excellent. Figure 3b is an intra-operative photograph.

Discussion

Despite complications in 8 of 40 tissue expanders inserted, 11 of the 12 cases were managed successfully by this technique. Expander exposure with secondary infection of the exposed area was the leading complication.

Results were frequently aesthetically far superior to those possible with available alternative techniques. Despite its limitations and potential for complications tissue expansion will continue to play an ever increasing role in burn reconstruction. The use of tissue

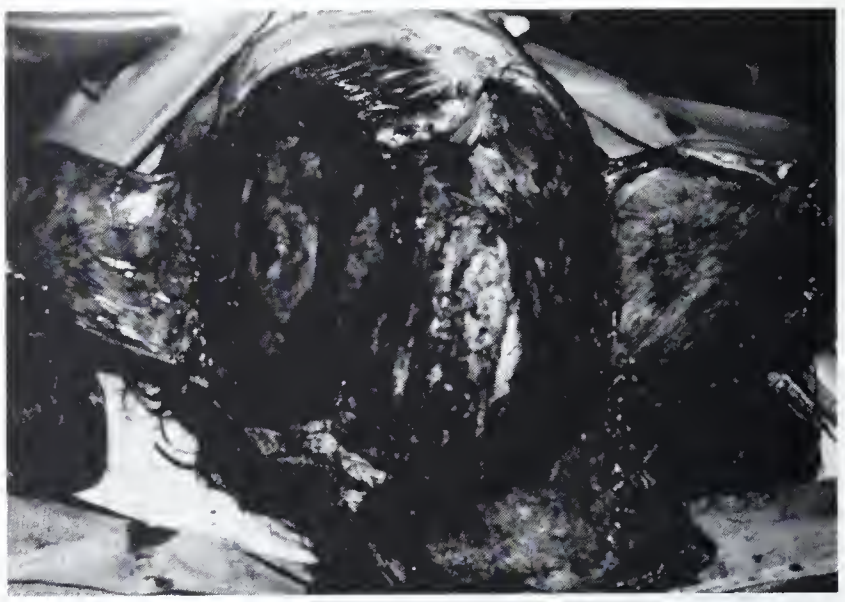

Figure 3b: The area of burn alopecia was excised and closed by direct advancement of expanded skin flaps. Post-operative photographs were not available.

expansion has become a preferred technique employed in burn scar reconstruction in selected patients at the Ross Tilley Burn Centre.

Acknowledgements

The authors are indebted to the nursing staff of the Ross Tilley Burn Centre (RTBC) for their unique commitment to the total nursing care of the burn victim. We are thankful for the role of all members of the RTBC "burn team".

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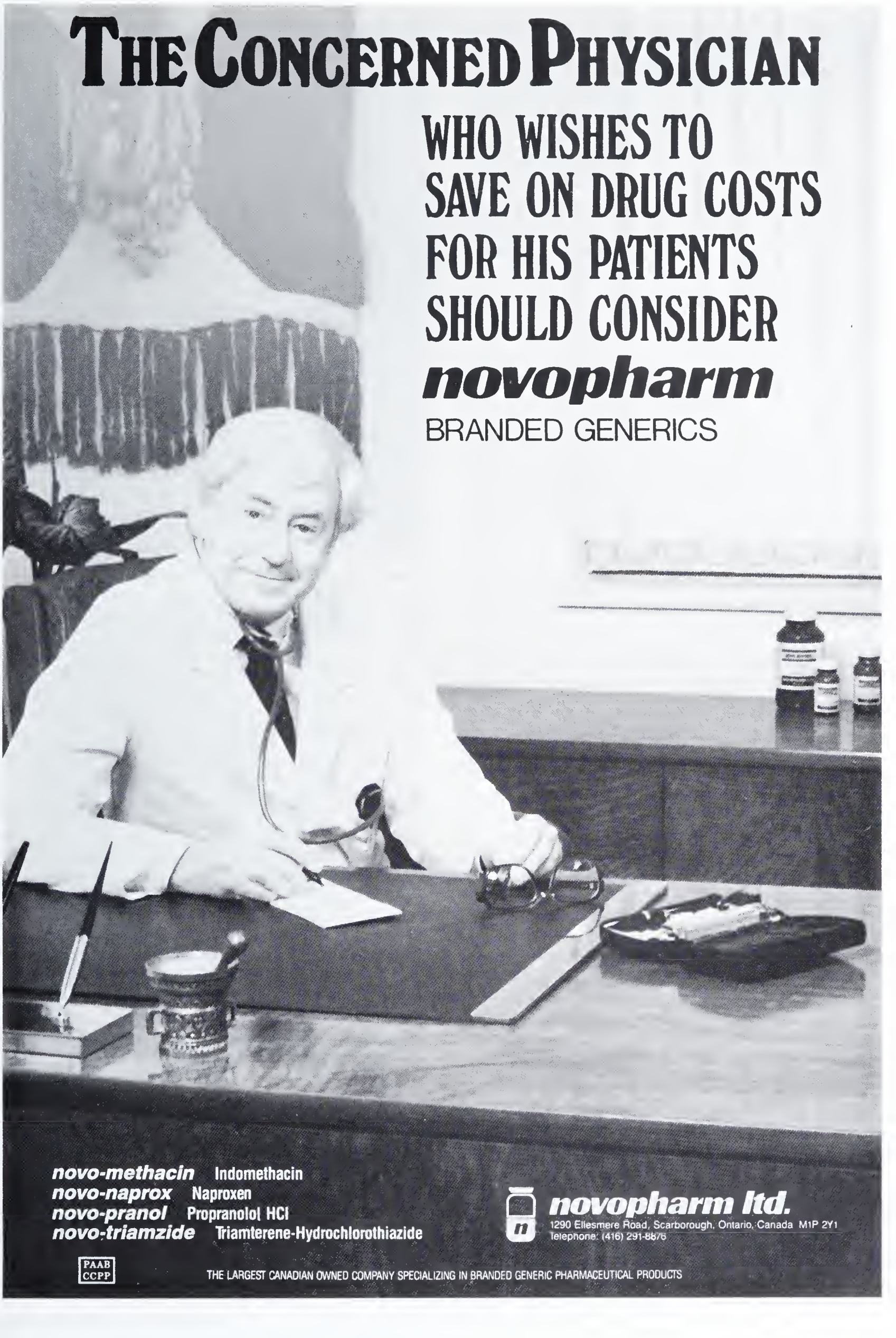

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A New Approach to Distal Femoral Varus Osteotomy for Valgus Deformity of the Knee

Joel A. Finkelstein, B.Sc. 8T8

Abstract

Valgus deformity of the knee with degenerative arthritis of the lateral compartment may be treated by a realignment osteotomy. This can be carried out through the proximal tibia; however, if there is superolateral tilt to the joint line the osteotomy should be performed through the distal femur. This will redistribute the weight to the medial compartment and at the same time make the joint line horizontal. An innovative surgical technique is described which guarantees precise correction without the need for mathematical calculation. Using a knee protocal, 35 patients, 24 with idiopathic osteoarthritis and 11 with post-traumatic changes in the lateral compartment were evaluated. An average follow-up of 3.9 years shows satisfactory results in appropriate selected cases.

Introduction

Valgus deformity of the knee may be developmental or post-traumatic; but common to all is an abnormal distribution of weight to the lateral compartment predisposing to degenerative changes in this area. A superolateral tilt of the joint line is often associated with genu valgum, hence the slope of the joint line cannot be corrected unless the osteotomy is done proximal to the joint. A high tibial osteotomy leaves the abnormal tilt uncorrected and the joint gradually subluxes due to lateral displacement of the tibia. A number of authors have described different techniques for a distal femoral varus osteotomy (DFVO) for the correction of genu valgum.[1 2 3]. In the technique described by Coventry, the anatomical axis as measured on a 3 foot standing AP x-ray and a wedge size is calculated that will need to be removed from the distal femur in order to attain adequate lateral compartment unloading. A 135° offset blade plate is used for fixation of the osteotomy[4]. This method, which is most widely used, allows for errors in the correction even after meticulous calculations.

The use of a 90° offset blade plate is the basis of this new approach technique whereby the fixation device itself ensures adequate and precise correction. It should be recalled that in the average person, the anatomical axis (femoral-tibial axis), has an inclination of 6° away from the mechanical axis, producing an anatomical valgus. This clinically presents as a straight knee. The mechanical axis during weight bearing is perpendicular to both the floor and the transcondylar line of the knee joint; thus both the lateral and medial compartments are equally loaded. If the anatomical axis is brought to an angle of 90° with the transcondylar line, the leg will be moved out of the natural valgus and the lateral compartment will be unloaded. For correction of the valgus deformity by DFVO, a 90° offset blade plate is used which is put in parallel to the transcondylar line. The angle between the medial femoral cortex and the transcondylar line is 90°. This gives an anatomical axis of approximately 0° and unloading of the lateral compartment. Very little error is possible by using this simple technique.

Surgical Technique

After the patient is suitably prepped and draped, the skin and fascia over the vastus medialis is incised and the muscle is dissected off the medial septum exposing the medial cortex of the femur and the medial femoral condyle. A guide wire is placed in the joint parallel to the joint surface along the transcondylar line. A second guide wire is then inserted parallel to the first guide wire about 1 cm from the articular surface, and an x-ray is taken to confirm that the second guide wire is parallel to the joint surface (Fig. 1). A chisel is inserted from medial to lateral and parallel to the guide wire, 2 to 2.5 cm from the joint surface (Fig. 2). The osteotomy is done just proximal to the adductor tubercle and a medially based wedge is removed from the proximal fragment (Fig. 3). The base of the wedge should be between 5 to 10 mm. The 90° offset blade plate is then inserted and the wedge is closed by bringing the medial femoral cortex up to the handle of the plate. Because of the discrepancy in diameter between the proximal and distal femoral shaft after a small amount of cortex is removed, the proximal cortical fragment can be impacted into the cancellous bone of the distal fragment (Fig. 4). This has the benefit of quicker healing of the osteotomy site as well as enabling for concurrent correction of minor flexion contractures of the knee. The angle between the medial femoral cortex and the transcondylar line is now 90° which gives an anatomical

Figure 1: X-ray showing insertion of the two guide wires parallel to the joint line.

Figure 2: Model demonstrates insertion of the chisel 2 to 2.5 cms from the joint line and parallel to the 2 guide wires.

axis of approximately 0° and unloading of the lateral compartment.

The patient is non-weight bearing for 6 weeks and partial weight bearing is continued for 3-6 months. In most situations the plate should be removed 18 months to 2 years following surgery. This is done for symptoms related to the plate, stress shielding or in anticipation of an arthroplasty.

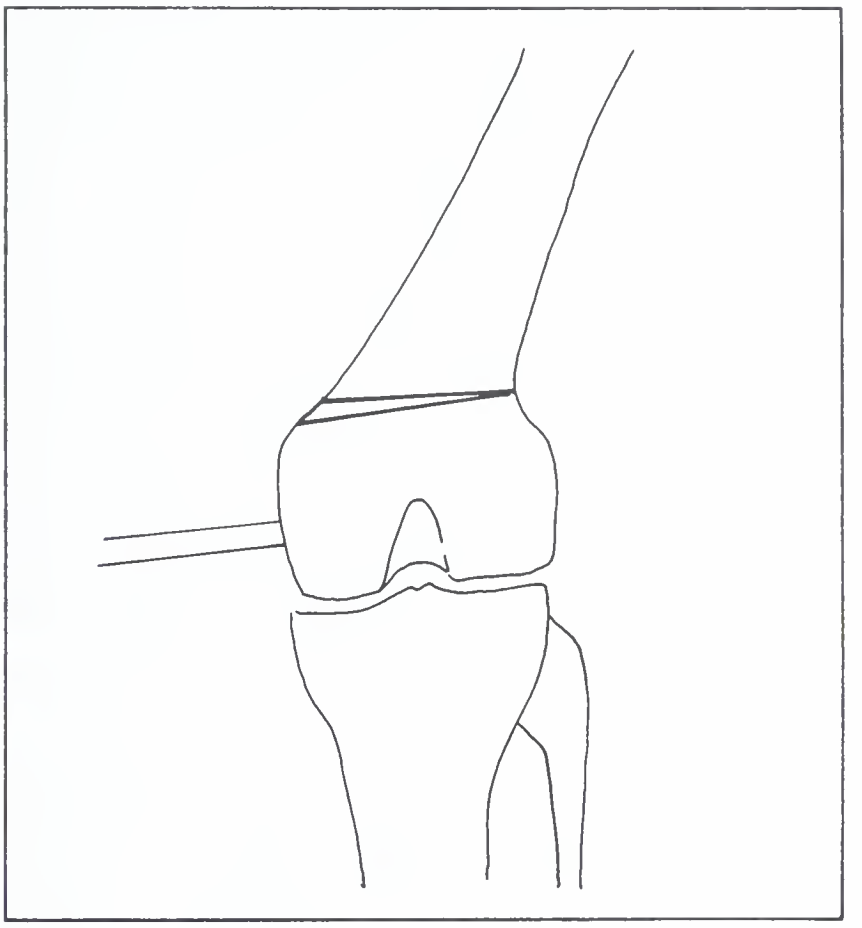

Figure 3: The osteotomy is carried out at the level of the adductor tubercle, parallel to the chisel, just proximal to the patello-femoral joint.

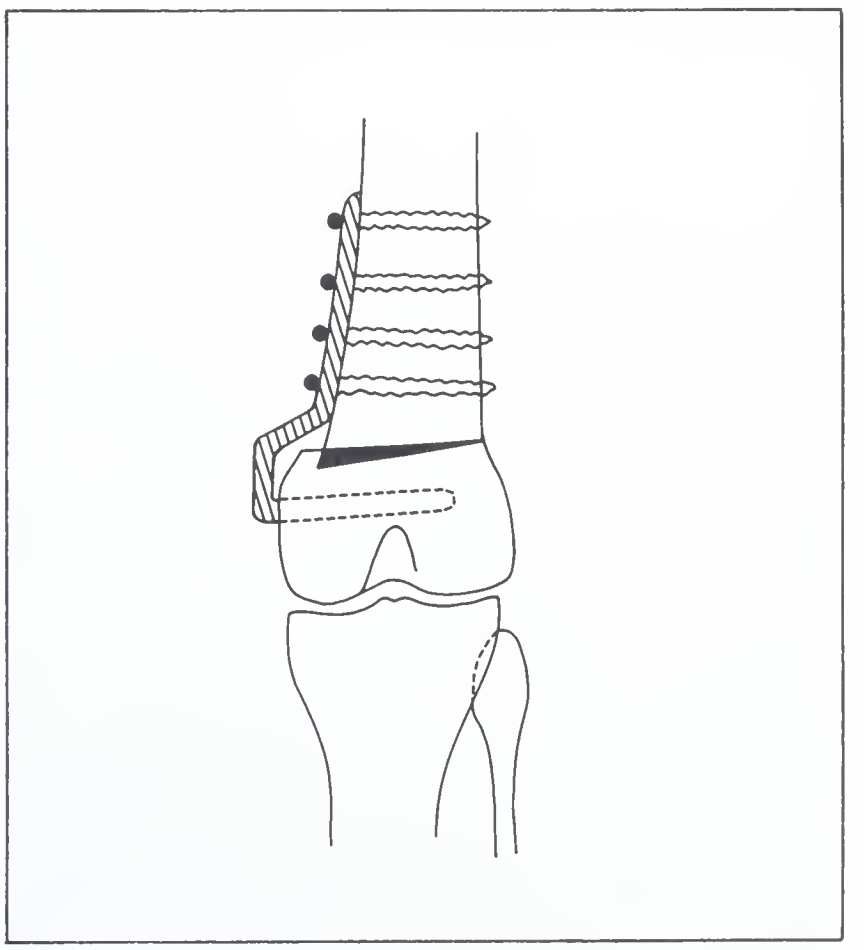

Figure 4: Drawing of the completed osteotomy with joint line now horizontal. Note the impaction of the proximal medial cortex and the 90° offset blade plate.

Results

35 patients were reviewed. The osteotomies were performed from 1974-1984 by 2 senior surgeons at the Mt. Sinai/Toronto General Orthopaedic Service in Toronto, Canada. There were 23 females and 12 males. The average age at surgery was 51 years (range 17-74). A detailed protocol that includes subjective and objective scoring was filled out for each patient. Evaluation of the DFVO was by a modified Hospital for Special Surgery knee-rating scale which awards a maximum of 100 points based on 3 scoring categories; pain, function and motion-axis (Table 1).[5] The overall average follow-up was 3.9 years (range 2.0-11.5).

Table 1
Modified Hospital for Special Surgery Knee-Rating Scale

I	Pain Intensity	0-30
II	Function	0-30
	walking distance	0-10
	instability	0-10
	walking aids	0-5
	climbing stairs	0-5
III	Motion-Axis	0-40
	range of motion	0-20
	flexion deformity	0-10
	axis	0-10
Total		100

After the correction all patients were clinically in varus. On a 3 foot standing x-ray, 24 patients had an anatomical axis of approximately 0°, 6 patients were between 2-8° varus, 4 were in 5° valgus. One patient with osteoporotic bone developed 9° varus subsequent to the blade shifting into the osteotomy site.

The 35 patients in this series are divided into 2 main groups dependant on etiology; 24 patients with idiopathic osteoarthritis and 11 patients with post-traumatic osteoarthritis.

I. Idiopathic Osteoarthritis

22 out of 24 patients had favourable results. The average total point increase for the improved patients was 35 (range 13-61). The entire group of 24 had an average increase of 28 points. The distribution of scores pre and post-operatively is shown in Figure 5. The most dramatic improvement was seen for pain with an average increase of 20 points for the 22 successful cases. The entire group of 24 had an average increase of 16.5 points. The function and motion-axis categories were also improved but less markedly. Figure 6 shows the pre and post-operative scores for pain, function and motion-axis. Figure 7 demonstrates a patient with idiopathic osteoarthritis and valgus deformity who had a DFVO in order to unload her severely diseased lateral compartment.

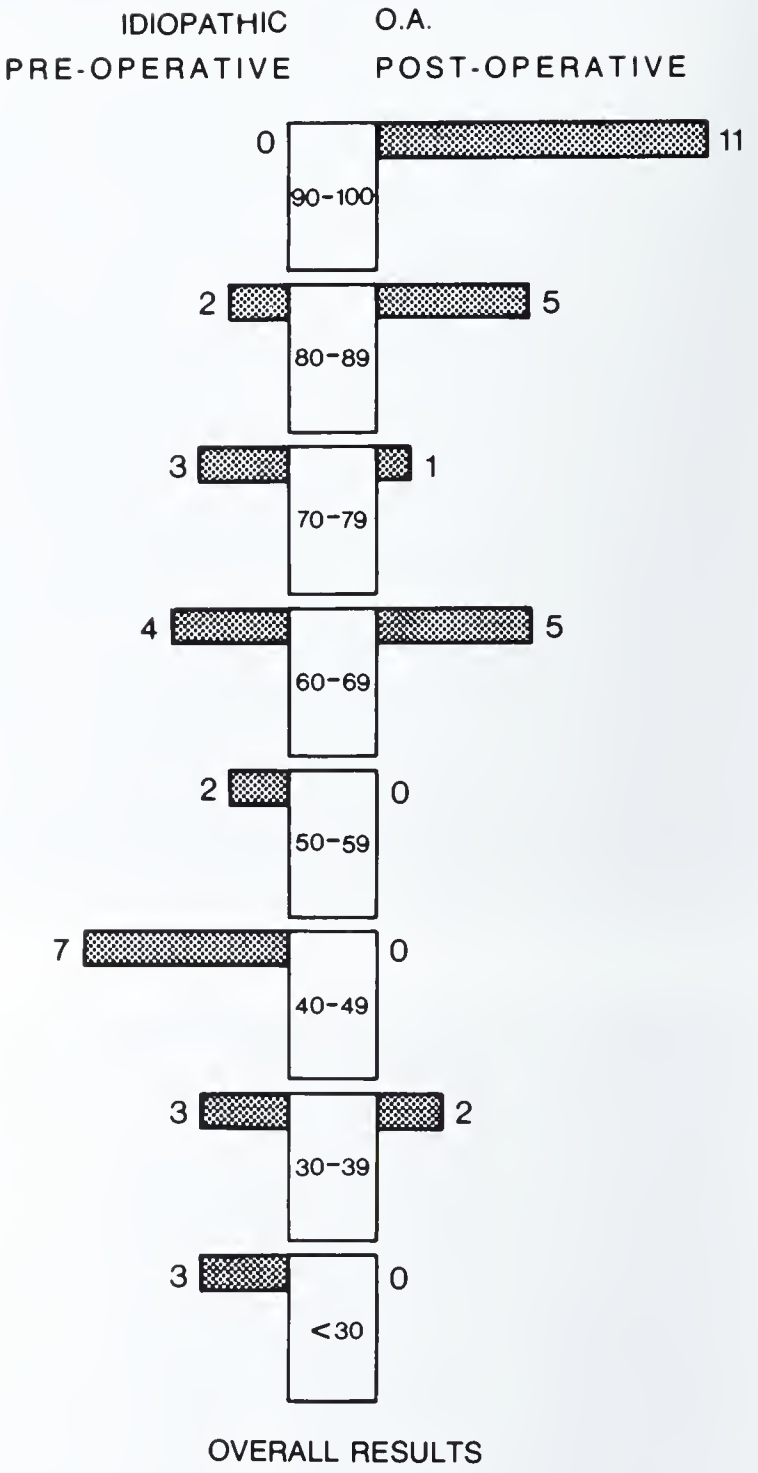

Figure 5: Distribution of scores for overall results pre and post-operatively for idiopathic osteoarthritis group.

II. Post-Traumatic Osteoarthritis

This was a heterogenous group of patients consisting of 2 malunited fractures of the femoral shaft, 3 lateral tibial plateau fractures and 6 patients treated with unipolar fresh osteochondral allografts for fractures of the lateral femoral condyle or lateral tibial plateau. Eight of the 11 patients improved their scores by an average of 25 points. Three patients did not improve their scores.

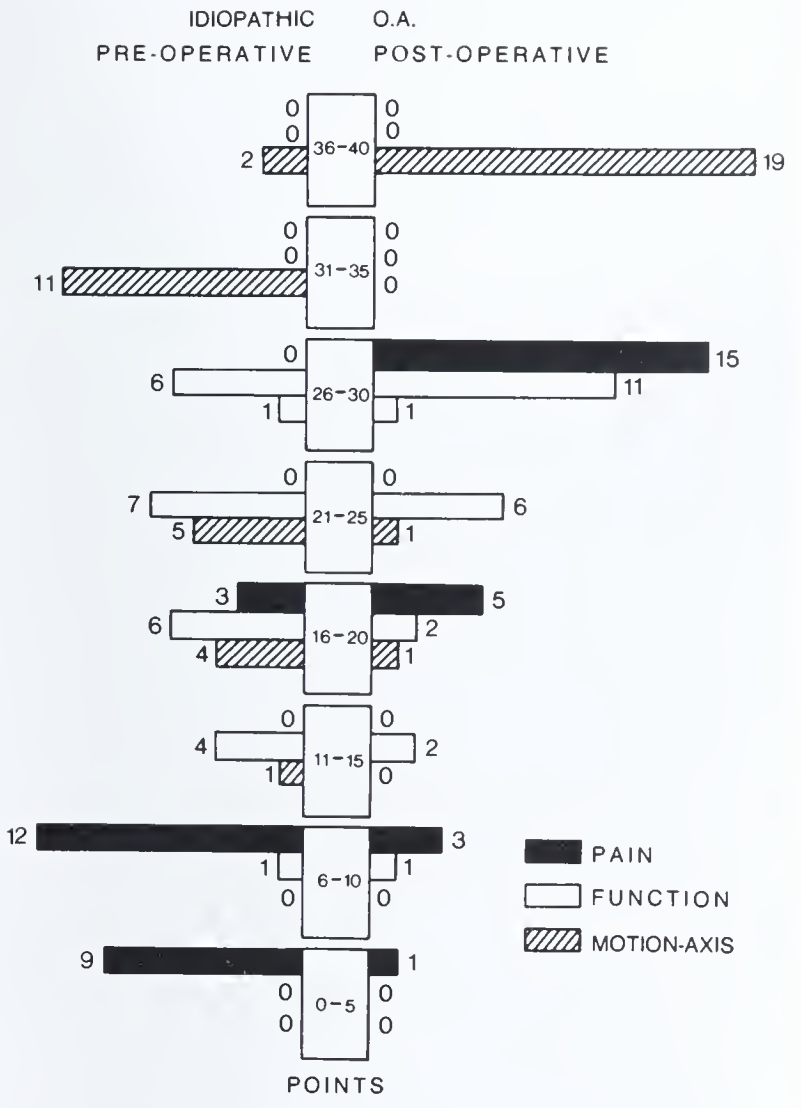

Figure 6: Pre and post-operative scores for the idiopathic osteoarthritic group for pain, function and motion-axis.

Figure 7: a) 65 year old female with osteoarthritis of the lateral compartment of the right knee and associated valgus deformity. Note the superolateral tilt to the joint line on the standing x-ray.

The femoral shaft fractures had post-operative point increases of 10 and 27 points.

Two of the 3 lateral tibial plateau fractures had an unsatisfactory result; each with a post-operative point decrease of 10 points. One patient gained 36 points post-operatively. All except one of the 6 allografted patients had post-operative point improvements. For these 5, the average pre-operative score was 65 and average post-operative score was 91; a 26 point improvement (range 21-37). Figure 8 shows a patient who fractured his lateral tibial plateau. After having a fresh osteochondral allograft of the lateral tibia, a DFVO was performed to unload the lateral compartment.

Discussion

Pain is usually the chief complaint of a patient with joint disease. This is reflected in the very low pre-operative score for pain, an average of 7.5 points. For the other scoring categories, in assessing which patients will benefit from a DFVO, the patient must have at least 90° of knee flexion or else a total knee replacement would be indicated. Hence, in this series the average pre-operative scores for function and motion-axis were already satisfactory, 21 and 24.5 points respectively.

The 2 failures in the idiopathic osteoarthritis group can be explained when reviewing their pre-operative physical findings. One patient had severe osteoporosis in whom the blade plate cut through the osteotomy site. If a DFVO is performed on bone of poor quality, partial weight bearing is recommended for a longer period of time. The second patient had significant medial compartment osteoarthritis in addition to the lateral compartment degeneration. In this case poor judgement was made in doing a DFVO since weight was transferred to an already diseased compartment. A total knee arthroplasty has since been performed.

Figure 7: b) 18 months after osteotomy and debridedment the femoral tibial axis is zero and the joint line is horizontal.

Figure 8: a) Fracture of lateral tibial plateau in a 32 year old male.

Figure 8: b) Two years following open reduction and internal fixation. There is depression of the lateral plateau and associated valgus with a sloping joint line.

Figure 8: c) Intra-operative x-ray showing fresh osteochondral allograft of the lateral plateau.

Figure 8: d) Postop two years the graft and osteotomy are well healed. The joint line is horizontal and the femoral tibial axis is zero degrees. Note the impaction of the medial cortex and the undisplaced lateral cortex.

In the post-traumatic osteoarthritis group, an osteotomy was performed to unload the lateral compartment. Excellent results occurred in the malunited femoral fractures. This is expected since the joint itself was not damaged directly, only the lateral compartment was overloaded by the valgus position of the knee. This deformity is best corrected as soon as possible in order to avoid secondary osteoarthritis. An unsatisfactory result occurred in 2 of the 3 patients with old lateral tibial plateau fractures. In these patients there were secondary osteoarthritic changes in the medial as well as the lateral compartment. The allograft patients improved after lateral compartment decompression. In significant fractures with prominent depression of the lateral tibial plateau and sloping of the joint line, allograft of the lateral plateau with DFVO is a recommended procedure. The one failure was due to the underlying disease, osteogenesis imperfecta.

Summary

A simpler and more precise technique using a 90° offset blade plate for distal femoral varus osteotomy was evaluated in this series of 35 patients with genu valgum. Twenty-two out of 24 patients with idiopathic osteoarthritis and 8 out of 11 patients with post-traumatic osteoarthritis had a satisfactory result according to a modified Hospital for Special Surgery knee-rating scale.

The pre-operative assessment is essential in determining which patients will benefit from this surgical procedure. The ideal patient has clinical and radiological valgus with superolateral tilt of the joint line with unicompartmental damage. If both medial and lateral compartments demonstrate degenerative changes, then a total knee arthroplasty is advised. In post-traumatic cases, with superolateral tilt of the joint line, a DFVO should be performed in order to prevent secondary osteoarthritic changes.

Acknowledgements

I would like to thank Dr. I. Farine, Head of Orthopaedics, Tel Hashomer Medical Center, Tel Aviv, Israel for his invaluable instruction and Dr. A.E. Gross, Chief Combined TGH/MSH Orthopaedic Service, Toronto for his help in preparation of this manuscript.

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Computers and Medical Imaging: A View to the Future

Lisa M.F. Thain B.A., 8T8 and Peter Wan, 8T8

Introduction

The discovery of the x-ray by Roentgen in 1895 heralded the beginning of radiology. Early x-ray images were produced by passing radiation from an x-ray tube through the object to be imaged and sensing the intensity of the rays (usually on a photographic plate).

Today the basic diagnostic imaging unit consists of an image producing unit as described above, an image processing unit and a display unit. An optional storage unit allows archiving of images.

With the application of the image processing unit to radiology, the clarity and variety of imaging techniques has grown tremendously in the past 10 years. However, because each new technology has brought with it ever growing costs, advances in the field of radiology have not been dictated solely by science, but also by money. The approximate price of each modality has been cited to give some insight into this area.

It is the addition of the image processing unit to modern day radiology that has produced the stunning images that you will see in this article.

The image processing unit is, of course, a computer.

Digital Plain Films

Conventional films are produced by passing radiation through the subject and onto photographic film where an image is stored. Digital radiographs are produced by replacing the photographic plate with a special phosphorus film. This plate is totally compatible with the cartridge film housing system used in most modern radiographical facilities today. The exposed image is stored on the surface of the phosphorus film and taken to an image reader. There, the surface of the plate is scanned by a red laser and the fluorescence is detected by a photometer. The image (of higher resolution than a normal radiograph) is stored electronically and given to an image processing unit. The phosphorus plate is erased by exposure to a special wavelength of light and reused. After passage through the image processing unit, the image may be displayed on a terminal or in printed form and stored in an image storage unit (usually on laser disk).

The real advantage of a digital system is cost. The cost per radiograph is minimal as film (the plate is reusable) and storage (laser disks costing about 600 dollars can store up to 6000 images) costs are negligible. Variations in exposure may be automatically taken into account and adjusted so that the radiologist can read all radiographs at a standard exposure. Very low radiation doses may be used — under-exposures may be enhanced easily. The contrast of the image may be adjusted and edge enhancement may be performed to allow more accurate inspection of subtle details (figures 1 and 2). Digital subtraction of previous radiographs may be performed to highlight even very subtle changes over time. Retrieval of data from archives is fast. Images from other modalities such as CT, MRI, nuclear medicine, ultrasound, etc. may be added into the system and a totally integrated radiology department becomes possible. Efficiency of organization and administration of the department will dictate that all future developments in radiology to be integrated in a system such as this.

Digital Subtraction Angiography

Digital Subtraction Angiography (DSA) is a radiographic technique which allows the visualization of vessels without the interference of surrounding tissues. The machine takes an x-ray of the area, called a mask film. Dye is then injected through a catheter and serial films are taken as the dye courses through the vessels. The computer then digitalizes all of the pictures and subtracts the mask from each of the subsequent films, leaving only a picture of the vessels with dye in them. By removing the rest of the picture, the vessels are much easier to see and less dye is necessary to see them.

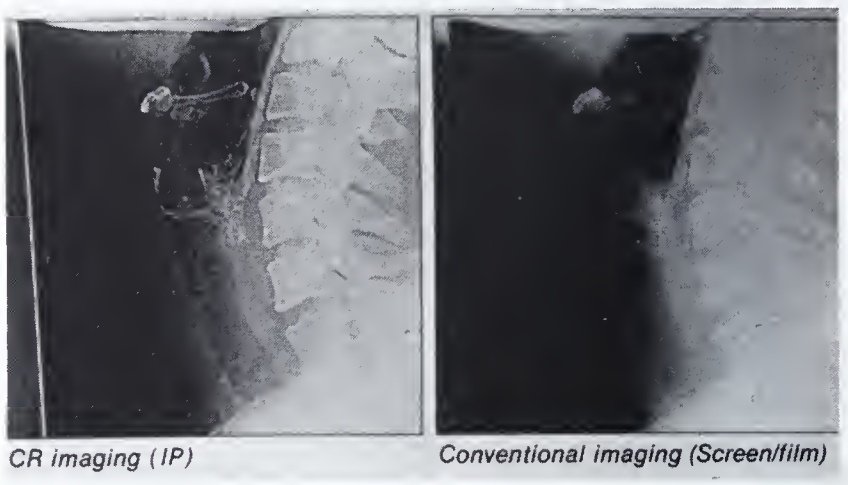

Figure 1: Comparison of computed and conventional radiographs. Note the greater vertebral detail and better visualisation of the bony structures of the pharynx and larynx. (Photograph courtesy of Toshiba of Canada Ltd.)

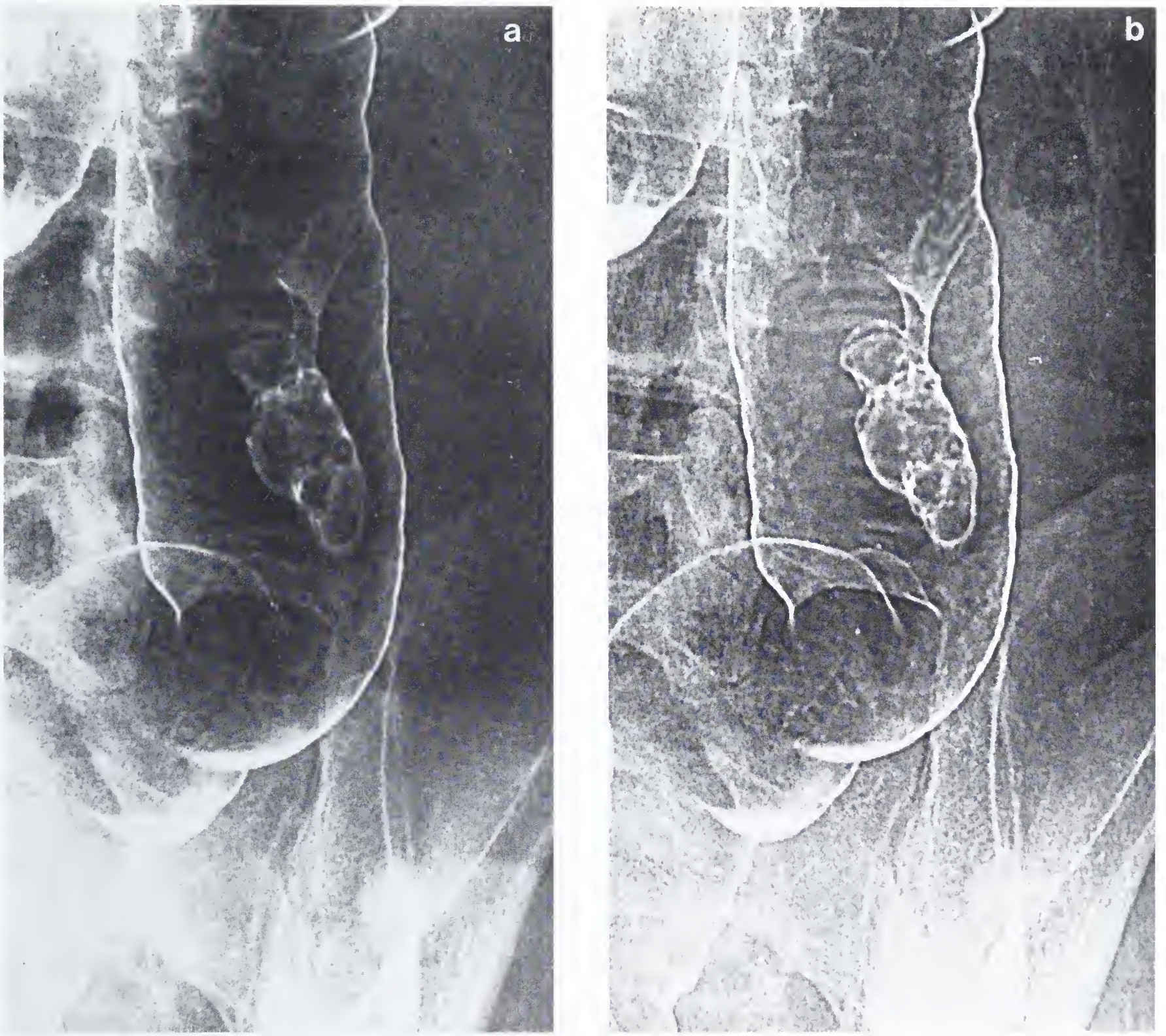

Figure 2: a) This digital film of the large bowel with double contrast shows a prominent sigmoid villous polyp. b) This film is the same radiograph as a) but with edge enhancement. (Photographs courtesy of Toshiba of Canada Ltd.)

Any of the films can be used as a mask, thereby allowing one, for example, to differentiate between the arterial and capillary or venous phases of filling (figure 3). DSA is recorded as cine (real time video) and as still films. Equipment costs for DSA are approximately $200,000 to $300,000.

Angiography in general provides a powerful diagnostic technique, a relatively non-invasive alternative for treatment of many vascular lesions and an adjunct to surgery in others. The advantages of DSA over regular angiography are the clarity of vessel imaging without the other tissues obscuring the view, and the use of one third the concentration of dye thereby costing less and decreasing the risk of allergic reactions or toxicity. Intravenous DSA was originally expected to supercede intra-arterial DSA. The intravenous technique is very safe, particularly when compared to the risk of embolic stroke when catheterizing the carotid arteries. The patient's post-procedural recovery time is significantly shorter than with the intra-arterial technique.

However, there are several disadvantages which have made intravenous DSA considerably less popular than predicted. Since one picture is subtracted from another taken at a different time, any movement which has occurred between the two pictures will result in an imperfect subtraction or movement artefact. This artefact is magnified in DSA. Patients must be very cooperative with regard to their breathing, swallowing, and other movements because of the greater time delay between the start of injection and the filling of the

arterial system. Secondly, the patient must have adequate cardiac output; a factor frequently absent in patients presenting for these studies. Thirdly, the number of injections may be limited to four or five due to the large amount of dye required for each injection and the total dose limits of dye to avoid toxicity. Fourthly, since all vessels become opacified, the vessels of interest may become obscured. Finally, there is an increased incidence of allergic rashes and vomiting with intravenous DSA than with intra-arterial DSA. Given these drawbacks, intravenous DSA has not lived up to its expected potential, although it is used in certain circumstances in some centers.

DSA is used for visualizing vessels in any part of the body, although the heart and brain are the two organs most frequently visualized. As an interventional tool, DSA is used to dilate stenoses, embolize tumours, and occlude fistulas or arterio-venous malformations. Two common examples of the use of DSA are the identification and treatment of coronary artery and renovascular stenoses. Since DSA allows excellent visualization with one third of the dye required for regular angiography, it can be used in patients with renal failure who would otherwise suffer unacceptable toxic renal damage from large quantities of radio-opaque dye (figure 3).

DSA is now well established in most major hospitals in North America as a diagnostic and interventional tool. The future of DSA lies in the proliferation of its uses as an interventional tool and in its use in community hospitals as an integral part of diagnosis and treatment of vascular lesions.

Computed Axial Tomography Scan

The birth of computed tomography (CT) about a decade ago was regarded as so significant that the age of neurology *B*efore *C*T has been indicated in years *BC*.

The principle of CT scanning is relatively simple. A

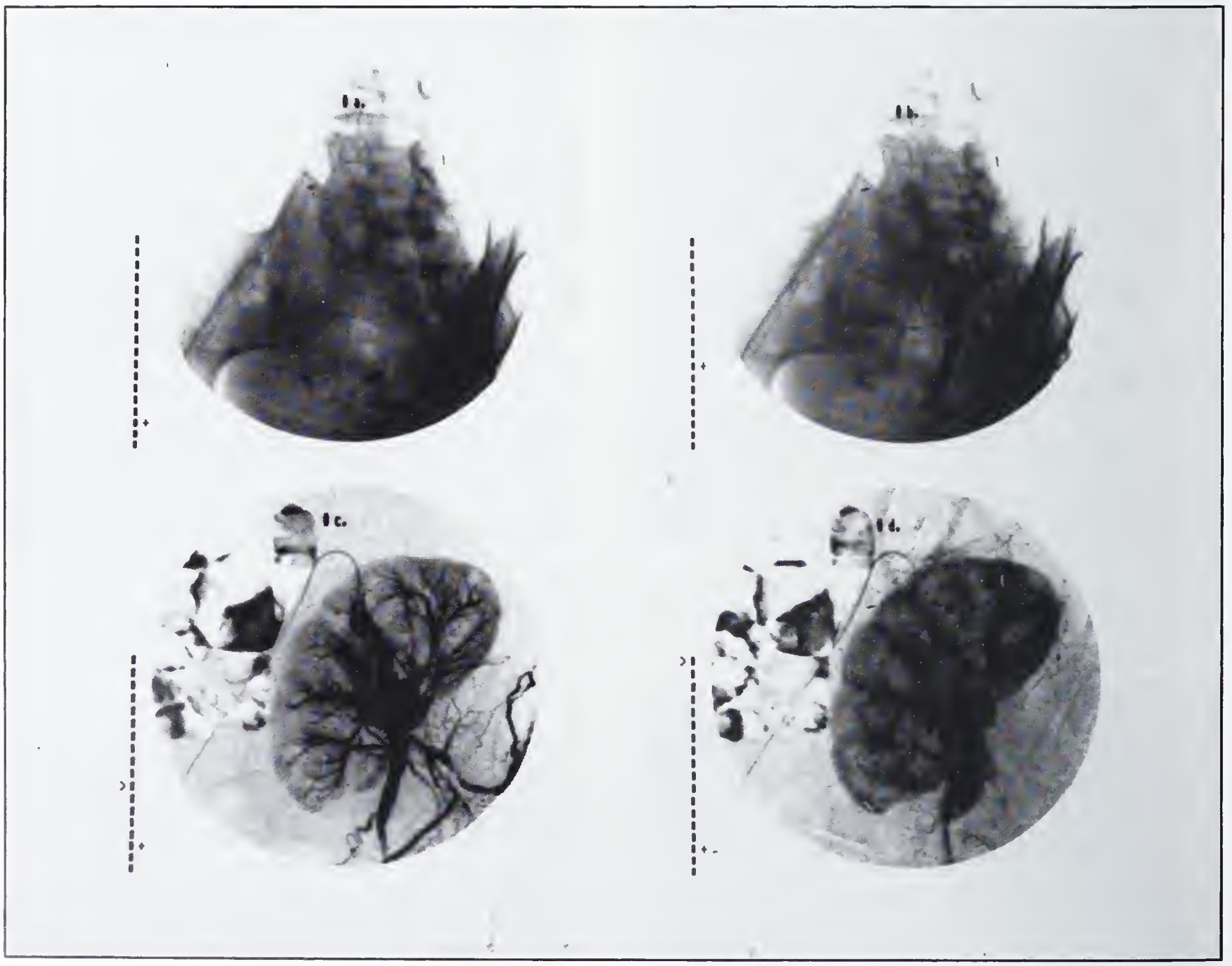

Figure 3: a) (Top left) Radiograph of a transplanted kidney in the left pelvic inlet, showing an angiographic catheter in the right common iliac artery and curving into the left common iliac. The tip of the catheter is resting at the anastomosis of the renal artery and the left iliac artery. b) (Top right) Radiograph as in a), with dye injected into the renal artery. c) (Bottom left) DSA radiograph created by subtracting figure a), "the mask", from figure b). Note the clarity of the vessels and movement artefacts created by bowel because these moved between the times that figure a) and figure b) were taken. d) (Bottom right) DSA radiograph created by subtracting an arterial phase mask from a capillary phase film. This shows a nephrogram. (Photographs courtesy of Dr. A. Tolia, Department of Radiology, St. Michael's Hospital, Toronto)

pencil thin beam of x-rays is passed through the subject. The attenuated rays are detected by sensors. Rays are then passed through the subject again but at a slightly rotated angle in the transverse plane of the subject. Many more exposures at different angles may be taken with the number of exposures depending on the equipment used. The absorption of the x-rays by various portions of the subject as detected by the sensors is fed into a processing unit and a cross sectional image of the subject is reconstructed. The time required to generate an image ranges from less than a second to a minute depending on the resolution of the image and the speed of processing. Equipment costs range from 1 to 1.5 million dollars per scanner.

Until recently, static plain sections were all CT was capable of displaying. Now with scan times down to about 0.6 seconds per slice, "dynamic" CTs are not far away. Dynamic imagery allows the high resolution views of function/physiology as well as anatomy. Myocardial movement, carotid pulsations, etc. would be imaged with a clarity many times of ultrasound. Of course, scan times of less than 0.1 seconds would have to be reached before the body in motion can be seen clearly.

Some machines can now produce 3-dimensional CTs (figures 4 and 5). Many sections are taken in close proximity and the processing unit reconstructs the original subject, adds shadows and clarifies details. The image may be rotated in any direction via a ball control so that the back as well as the sides may be seen. Tissues of various densities may be "dissected" away to reveal structures on the interior. For instance, 3D CT has become a standard procedure before brain surgery in some centers in the United States. Contrast dye is injected into the intracranial vessels before a 3D CT is performed in order to enhance the cerebral arteries.

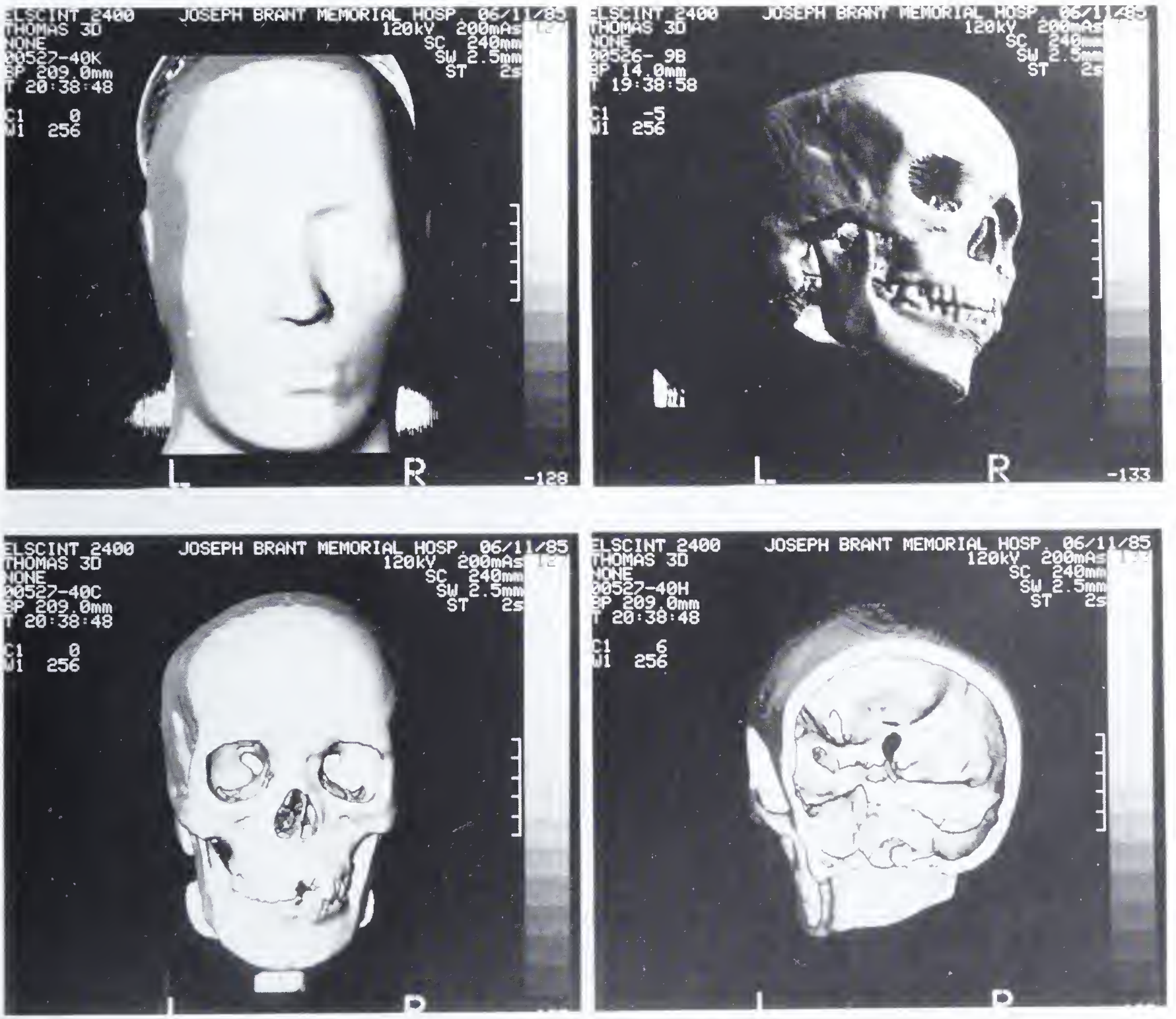

Figure 4: A 3-D CT of the skull of a patient is shown here with soft tissues (top left), without soft tissues (bottom left), rotated slightly to the patient's left (top right), and from an oblique posterior view with the posterior 1/4 of the cranium removed to show interior bony structures. (Photograph courtesy of Elscint Canada Ltd.)

Neurosurgeons can then manipulate the image and perform "experimental electronic surgery" with full view of the vasculature to ascertain the best approach.

Positron Emission Tomography

Positron emission tomography (PET) uses short lived radioactive substances, created in a cyclotron, to assess blood supply or metabolism of a given tissue. The radionuclide decays by emitting a positron. When the positron collides with an electron, both are destroyed and the energy is emitted as two photons moving in opposite directions. Each photon is received by a crystal which absorbs the energy and makes a flash of light. If two photons arrive at opposite detectors within a certain amount of time, then they are said to be in coincidence or arising from the same destruction event. This places their origin along a line between the two detectors. By assessing the difference between the time of arrival of the first photon and that of the second, the origin of the two can be more accurately identified along the line. This event occurs millions of times and a computer puts all of the points together on a matrix to reconstruct the image. PET scans the body transversely and it also reconstructs sagittal and coronal images. Current PET scanning techniques provide a spatial resolution of 0.5 to 1.0 cm within the transverse plane and 0.8 to 2.0 cm in the third dimension (thickness).

Because of the necessity of a particle accelerator (cyclotron) PET scan facilities are extremely expensive. Approximate costs are about 2 million dollars or more.

The use of PET scanning has advantages over the standard nuclear medicine scan because it allows a quantitative rather than qualitative measure of the concentration of isotope in an area of the body. It has an advantage over SPECT (see below) scanning because some of the short-lived radionuclides are biologically active, such as hydrogen, carbon, nitrogen, or oxygen. These can be incorporated into compounds such as fatty acids or glucose to assess metabolism as well as blood flow and blood volume.

PET scanning can be used to study diseases such as epilepsy, schizophrenia, Parkinson's disease, stroke,

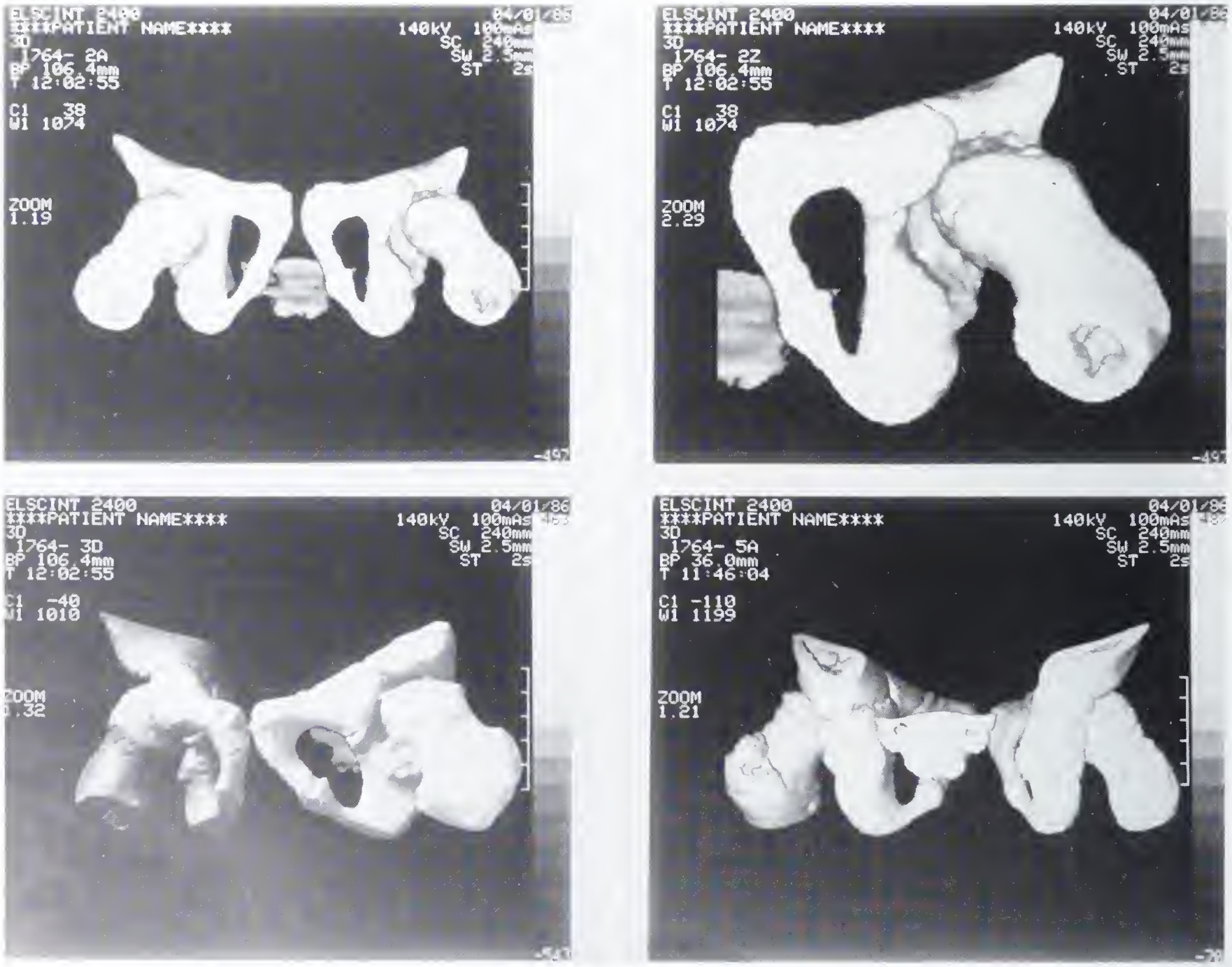

Figure 5: 3-D CT images of a patient with Legg-Perthe's disease. The disease is characterized by avascular necrosis of the femoral epiphysis (in this case, the patient's left). An inferior anterior midline view is shown (top left) as well as a left oblique (bottom left), magnified left oblique (top right), and a posterior view (bottom right). (Photograph courtesy of Elscint Canada Ltd.)

and myocardial ischemia. By assessing both the blood supply and the metabolic function of a tissue, an accurate assessment of the overall function of the tissue can be made. An example of PET scanning is shown on the cover of this issue of the Journal (figure 6). The first scan shows the distribution of glucose consumption in a tomographic slice through the thalamus and striatum after injecting [18F] fluoro-deoxyglucose into the patient. Pink represents high glucose consumption while yellow to blue represent decreasing levels of glucose consumption. The pink area in the left insula is due to activation of the primary auditory cortex. The second scan was made after injection 6 [18F] fluoro-L-dopa. The comma shapes in the center are due to 18F-labelled dopamine in the striatum of a normal patient.

PET imaging is currently limited to a few major medical centers. In the future, the imagers and cyclotrons should become less expensive and less complex. The images will continue to increase in resolution through the use of more advanced imaging devices and computer programs. Finally, with the development of more specific radionuclides, detailed biochemistry of the body will be available for study. As a clinical tool, this may provide diagnoses for inborn errors of metabolism and other biochemical abnormalities. As a research tool, it will be useful in understanding the underlying biochemistry of such diseases as Alzheimer's, diabetes, and the muscular dystrophies.

Single Photon Emission Computed Tomography

Single photon emission computed tomography (SPECT) is a radiographic technique which creates images in a similar way as PET imaging. SPECT provides information somewhat less accurately than PET, but at a much lower cost since a cyclotron is not required to create the radioactive materials. The gamma detector apparatus costs approximately $200,000 to $300,000.

SPECT uses commercially available isotopes attached to microspheres. These spheres are injected into a blood vessel as a suspension. They lodge in the first capillary bed which they encounter and are slowly washed out by the continuing blood. The rate of washout correlates to the rate of blood flow to the area.

The radionuclide emits single gamma photons which are received by a gamma camera. The camera is shaped like a doughnut and receives photons from a 6.4 mm thick transverse slice of the body. Each photon received is digitized according to its spatial coordinates and stored for later reconstruction of the organ. The computer sums the recordings over time. The camera then moves down the body to the next contiguous 6.4 mm slice and repeats the process. A scan takes two to 26 minutes, depending on the amount of radionuclide present and the part of the body being scanned.

After the scan is completed, the computer reconstructs the image and slices it coronally and sagittally. It prints transverse, coronal, and sagittal sections of the image.

SPECT identifies lesions with decreased or increased blood supply more accurately than a nuclear scan because it images the total volume of the organ and cuts it in three planes. It also eliminates surrounding radionuclide activity, thereby increasing the contrast of a lesion. Whereas DSA concentrates on relatively large vessels, SPECT assesses all vessels. This is particularly important in small vessel disease. SPECT can also assess quantitatively the volume of an area containing radionuclide as well as the concentration of that radionuclide. Using this information, SPECT can provide information about regional blood flow.

SPECT can assess any organ which has traditionally been assessed by nuclear medicine scanning. For example, SPECT can identify multiple areas of decreased perfusion corresponding to deposits of hepatocellular carcinoma (figure 7). These areas are clearer in the SPECT scans than in the flat nuclear medicine scan. With cuts in three planes, each nodule can be assessed more accurately with respect to its size and location. Another common use of SPECT is to identify areas of decreased perfusion in the lungs secondary to embolism. SPECT is far more accurate than standard nuclear medicine in distinguishing major vessels and bronchi from poorly perfused tissue as well as identifying areas of poor perfusion. SPECT is not able to adequately assess ventilation because it takes too long to complete its scan of the lungs.

As a tool which can potentially be used in a community hospital, SPECT will be very helpful in identifying tumours or infarctions quickly and with relatively little radiation. As the technology progresses, it should soon be able to adequately assess ventilation of the lungs, thereby providing accurate V/Q scans. The determinations of volume and concentration of radionuclide are still in their infancy. In the near future, it is expected that these techniques will be refined.

Nuclear Magnetic Resonance Imaging

Nuclear magnetic resonance imaging (MRI) is a relative newcomer to the field of radiology. The principle behind MRI involves understanding of the energies in the motions of the nuclei of atoms. All protons and neutrons in nuclei spin acting like minute magnets. The axes of the spin of the many protons and neutrons are usually pointing opposite each other and the resulting magnetism produced by them in the nucleus cancels out. However, if there is an odd number of protons and neutrons, a significant residual nuclear magnetism is left. The strongest nuclear magnet is found in a single proton or hydrogen-1 nucleus. Other weaker nuclear magnets include phosphorus-31 and sodium-23. All of these nuclear magnets are aligned randomly in the body due to thermal agitation. Thus, the whole body magnetism is usually negligible. However, they can be aligned by a magnetic field of sufficient strength. MRI imaging uses fields in the order of 5,000 to 20,000 gauss (8,000 to 33,000 times the strength of earth's magnetic field). Energy supplied via radio waves will knock the alignment of these nuclei out of the direction of the applied magnetic field. If the radio waves are turned off, the nuclei realign to the magnetic field and emit some radio waves of their own. The magnitude and wavelength of

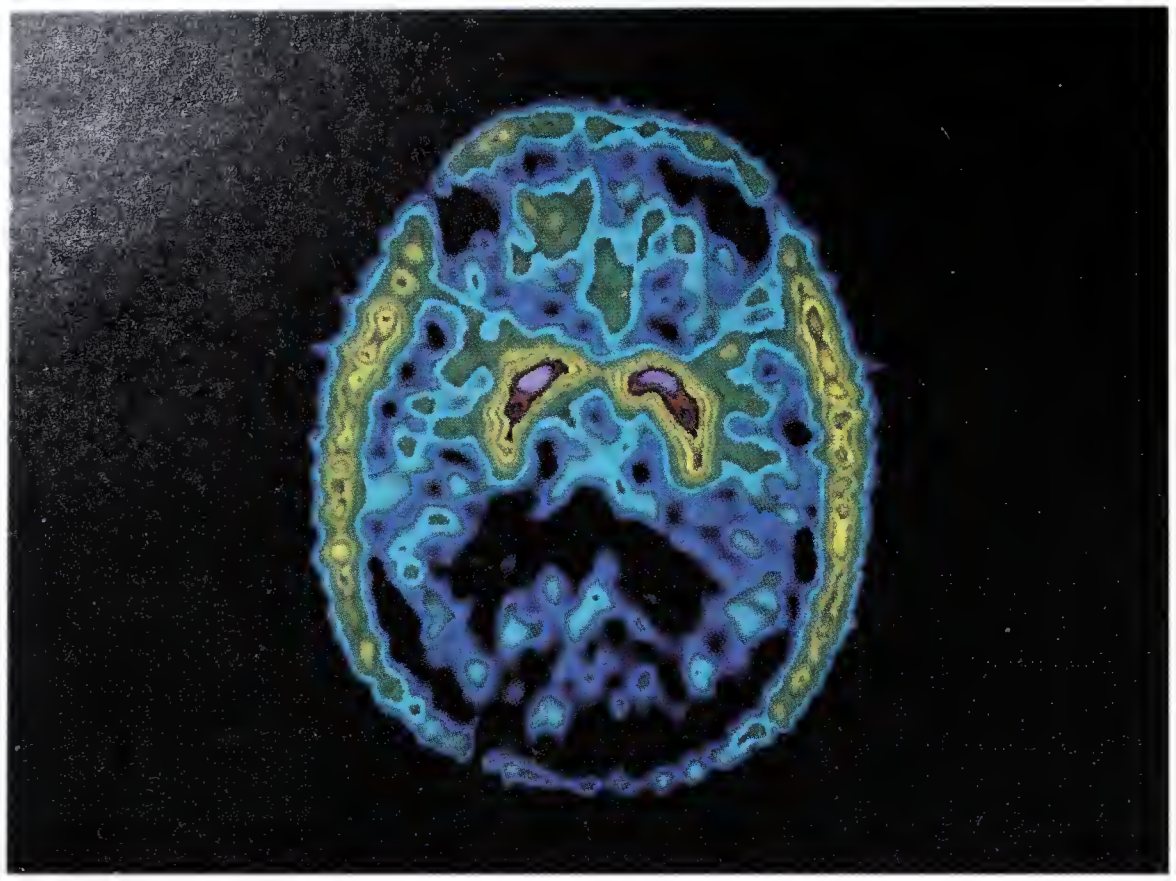

Figure 6: b) PET scan using 6[18F]fluoro-L-dopa. The comma shapes in the centre are due to 18F-labelled dopamine in the striatum of a normal individual. The rind of activity in these pictures is scalp. (Photographs courtesy of Dr. E.S. Garnett, Department of Nuclear Medicine, McMaster University Medical Centre, Hamilton)

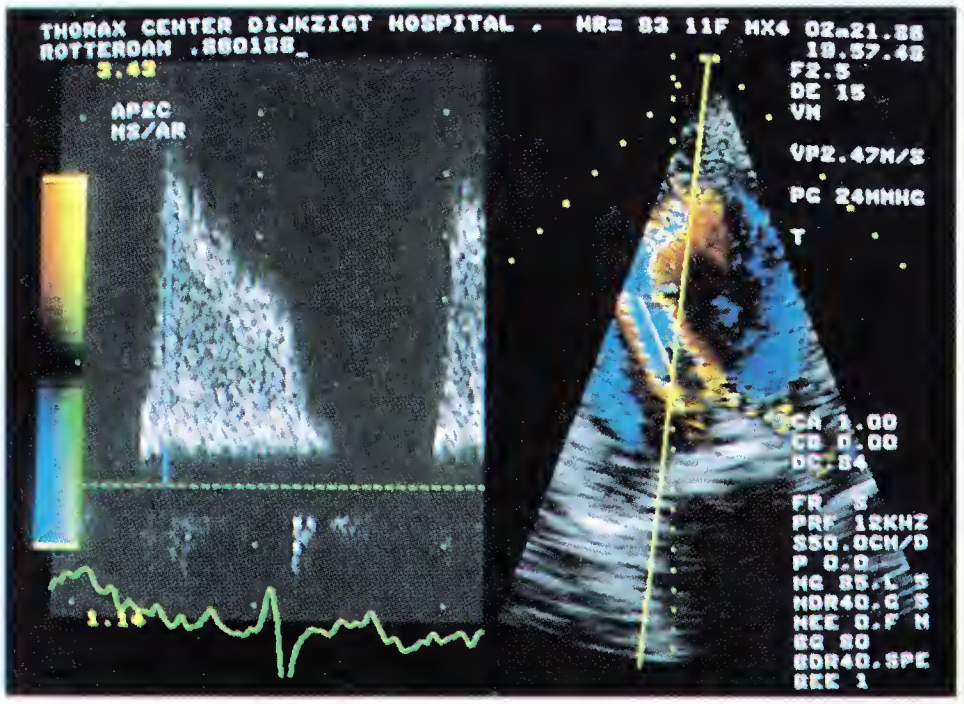

Figure 9: A diastolic apical long axis view of a patient with mitral stenosis is shown to the right. The stenotic jet is visualized and bends off towards the apex as it hits the left ventricular wall. Central aliasing of high velocities in the middle of the stenotic jet which are encoded in blue create a "flame-shaped" appearance of the jet. Continuous wave Doppler sampling is performed along a sound beam indicated on the flow map and the spectral velocity output is shown to the left. Note also the small jet in the left ventricular outflow tract indicating aortic regurgitation. (Photograph courtesy of Toshiba Corporation of Canada)

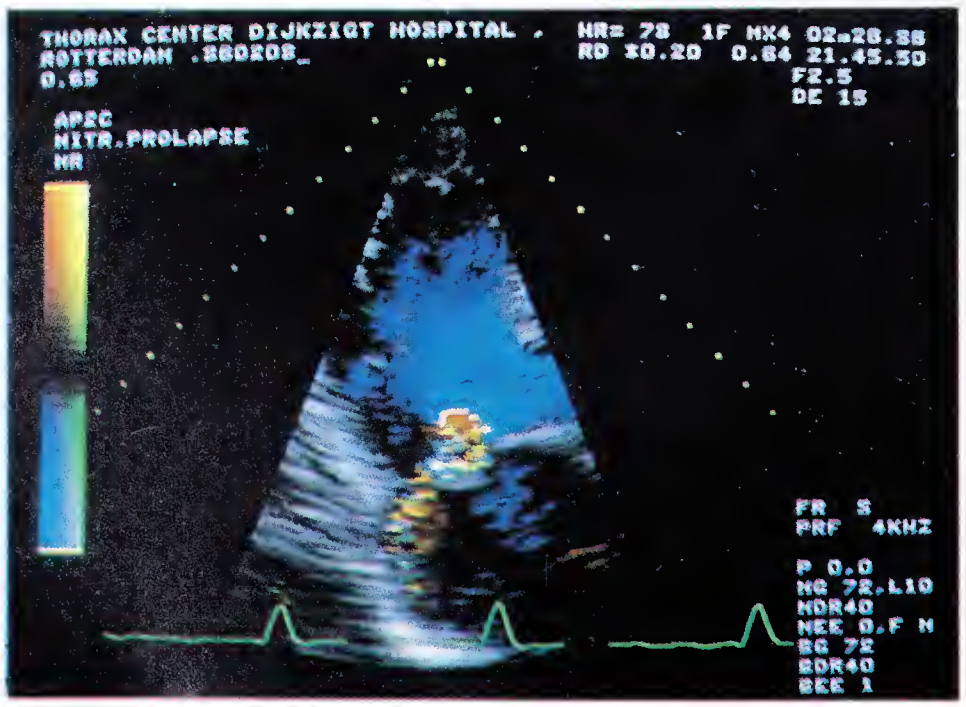

Figure 10: Systolic apical long axis view of a patient with prolapse of the anterior mitral valve leaflet. The regurgitant jet is eccentric and is directed towards the lateral left atrial wall. Note the mosaic pattern which indicates the turbulence and the increasing blood velocity proximal to the defect within the left ventricular cavity. Note that conventional blind Doppler interrogation may result in recording the velocity within the ventricle and the presence of the eccentric jet may have been missed. (Photograph courtesy of Toshiba Corporation of Canada)

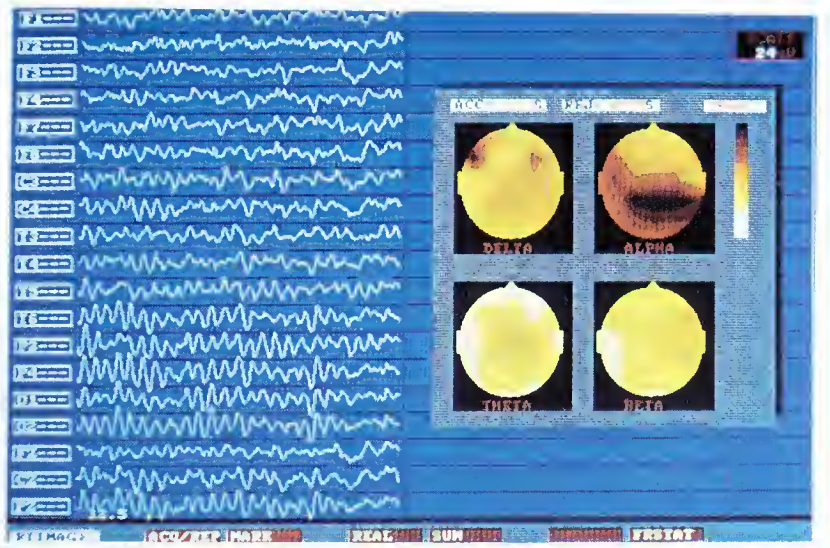

Figure 11: a) A display of the brain's contour mapped spectral energy (right), along with a 2.5 second portion of the 10 seconds of real-time EEG (left) from which the developing spectral maps were constructed. In the maps, the patient is seen from a vantage point above his/her head and the activity over the surface of the brain in colours. The darker colours in the map indicate greater amount of cortical electrical activity.

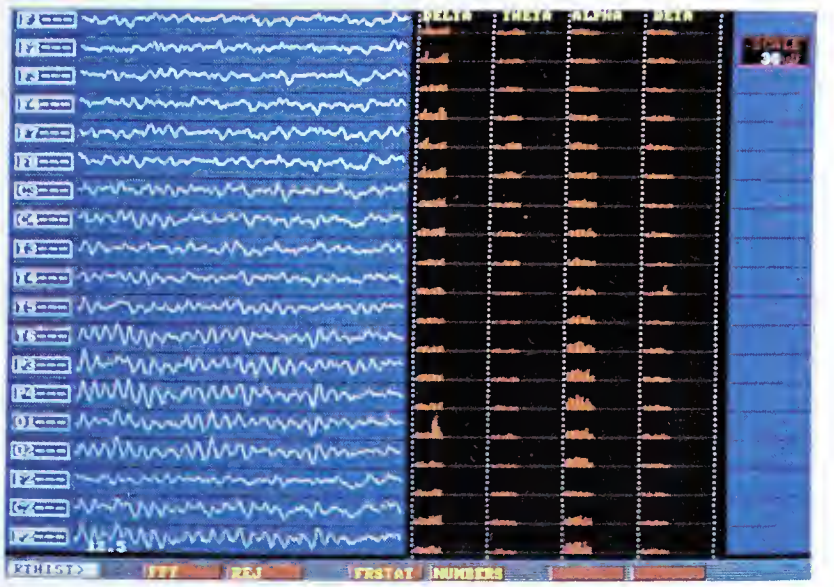

Figure 11: b) Histograms (right) showing the absolute amounts of energy in the standard delta, theta, alpha, and beta frequency bands that are being constructed from the digitized EEG data. The current 2.5 second portion of the 10 second EEG being analyzed is also shown (left).

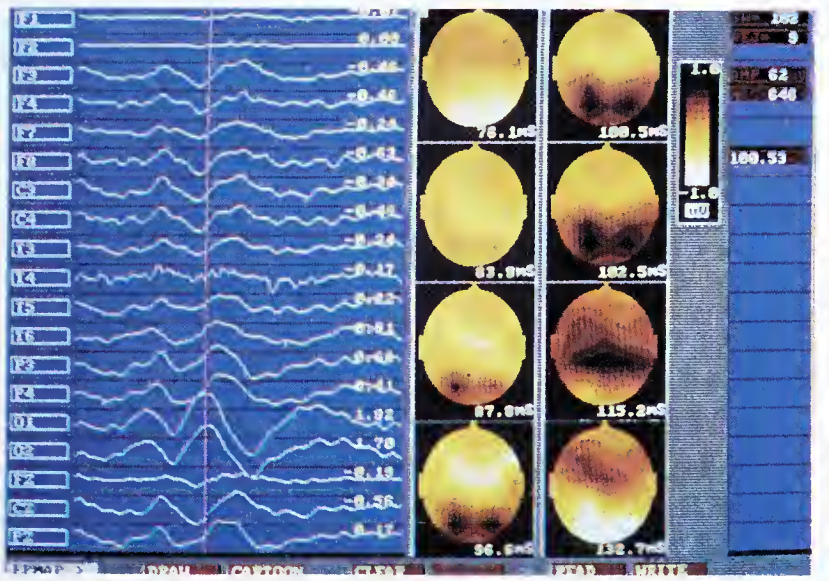

Figure 11: c) The contour maps (right) are derived from an analysis of the energy peaks and troughs in the averaged response from each of the brain regions (left) produced by repeated flashes of visual stimulation.

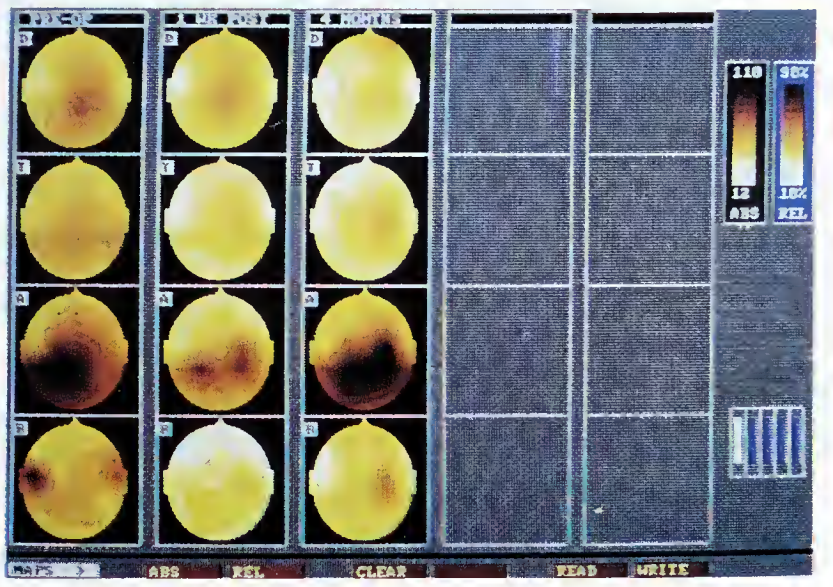

Figure 11: d) Three sets of mapped EEGs showing the pre-, 1 week post-, and 4 week post- operative distributions of delta, theta, alpha, and beta energies. The patient had a right parasagittal meningioma resected. Pre-operative EEG: there is an excessive amount of delta (slow) energy over the tumour and an asymmetrical distribution of alpha energy in the back of the head. Post-operative EEG: following tumour removal the delta energy decreases and the alpha energy assumes a more appropriate symmetrical distribution with a slight excess in the right posterior region. (These images were produced on the QSI system 9000 machine. This colour plate courtesy of QSI Inc., Ste. 205, 512 King St. E., Toronto, M5A 1M2, (416) 863-0828.)

the emitted radio waves and the duration of emission depend on the chemical environment the nucleus is in as well as the magnetic field applied. These emitted waves can be detected and, through processing similar to that for the CT, images may be reconstructed in several planes. An image takes several minutes to generate. The advantage of MRI over conventional radiology is that the subject is not exposed to ionizing radiation. MRI machines cost approximately 1.5 to 2 million dollars but because of additional costs for shielding and housing of the supercooled magnet, the final price is somewhat higher. Electrical bills and annual operating costs make MRI prohibitively expensive for many institutions.

The images are clear and show detail of both soft and hard tissues (figure 8). In the future, we can expect firstly, faster scan times. Motion of various body parts currently to limit imaging in certain areas. Secondly, 3-dimensional MRIs will be developed. Similar to 3D CT, these will allow rotation in all angles and have electronic dissection features. Thirdly, special injectable magnetic "dyes" of extremely low toxicity and required in miniscule amounts will be developed to enhance vasculature. Fourthly, with the addition of dynamic MRIs, truly whole body 3D imaging of physiology as well as anatomy will be available. Fifthly, imaging using the natural phosphorus-31, sodium-23, carbon-13, calcium-43, and iron-19 isotopes allows study of practically all aspects of metabolism. For instance, ATP and ADP may be differentiated and cellular biochemistry may be studied. Eventually, MRI with the capability of imaging on the microscopic level may be applied to the imaging of everything from gross anatomy to molecular genetics.

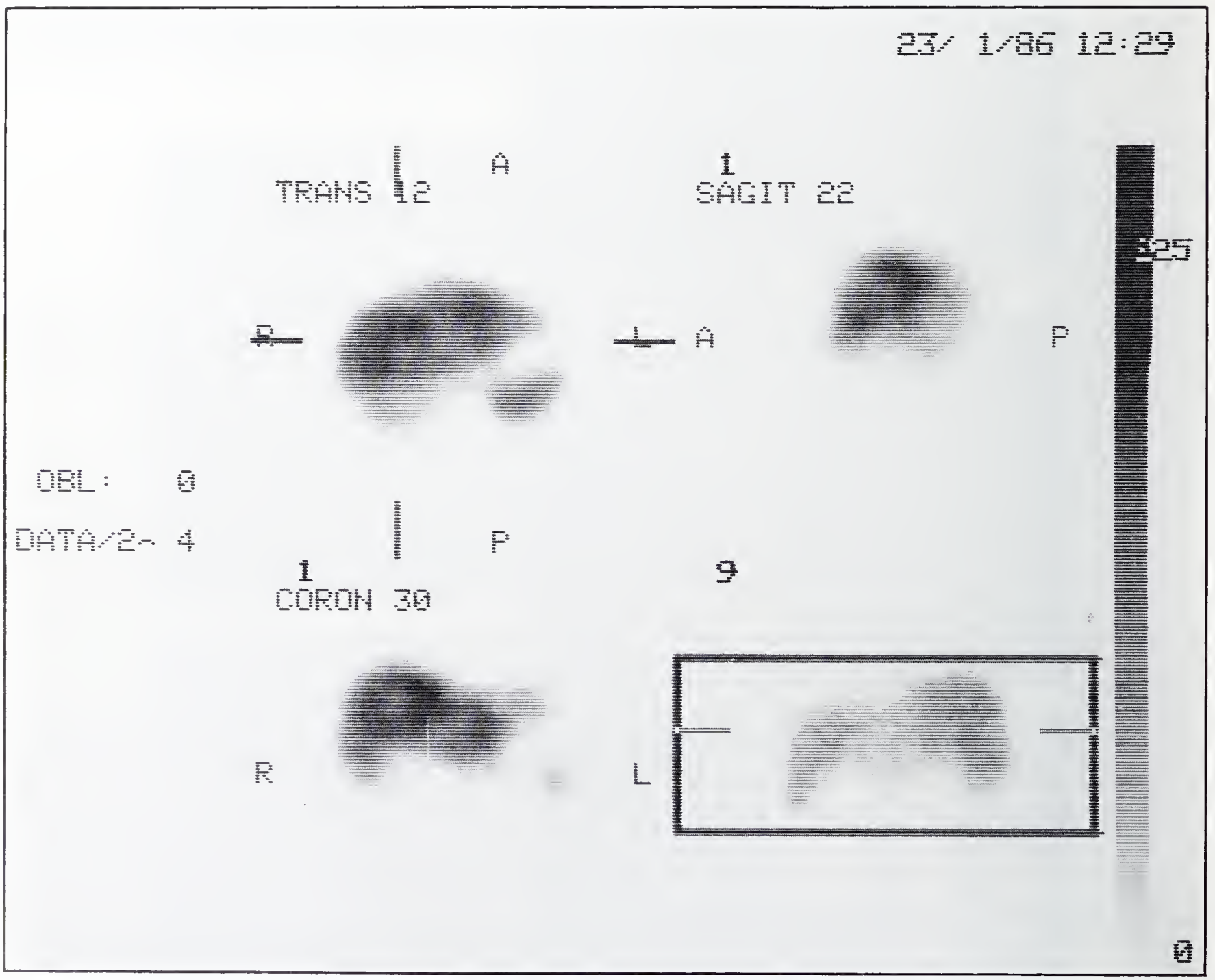

Figure 7: SPECT scan of the liver showing multiple nodules of hepatocellular carcinoma. The blocked off profile of the liver at bottom right has two horizontal dashes indicating the level of the transverse section shown at top left. A coronal section is produced at the level indicated by the horizontal dashes labeled 'R' and 'L' from the transverse section. A sagittal section is produced at the level of the vertical dashes indicated on the transverse section. Tumour is represented by defects in uptake of the Tc-99m sulfur colloid. (Photograph courtesy of Dr. S. Houle, Department of Nuclear Medicine, Toronto General Hospital, Toronto)

Doppler Ultrasound and Color Doppler Flow Imaging

Doppler ultrasound (DUS) combines standard ultrasound techniques with a doppler flow meter. It is used almost exclusively to assess blood flow through the heart and great vessels. The doppler sends a signal toward a blood vessel or valve and then receives the same signal a known distance away. The time between sending and receiving the signal is equivalent to the velocity of blood flow. The volume flow rate is obtained by integrating over time the product of the mean flow velocity and the cross-sectional area of the vessel or valve. DUS is recorded as a frozen ultrasound of the heart or vessel with a line indicating the site of doppler application. The doppler is recorded below the image of the heart as a line of waves with height equivalent to velocity. An ECG is recorded in synchrony with the doppler recording. The main problem with this technique is that structural and functional abnormalities cannot be simultaneously assessed. Many views of the heart and many doppler flow patterns within each view may be necessary to assess a given abnormality.

A new technique called "color doppler flow imaging" (CDFI) has combined the flow patterns with the ultrasound image, giving a visual image of volume, velocity, and direction of blood flow. CDFI uses a "moving target indicator" system which was originally developed for radar detection systems. The velocity of echoes is sampled several times along the line of site of the doppler head. Since the velocity must be sampled several times, the maximum flow and the segment of flow measured are limited. This system allows the assessment of blood flow at many sites at once whereas the conventional doppler technique allowed only one site at a time to be assessed.

Flow toward the transducer in CDFI is coded red while flow away from the transducer is coded blue. The intensity of the color correlates with the velocity of the flow while the diameter of the flow indicates the volume. Turbulence is coded green or yellow. Due to the limit on the speed with which this system can sample a given stream, very rapid flow rates appear coded in the color for the opposite direction of flow. This phenomenon is called "aliasing". It is very useful for identifying the most rapid region of flow within a stream.

The spatially oriented blood flow information from CDFI provides a rapid and accurate assessment of abnormal blood flow patterns. In the event of multiple valve disease, the flow patterns caused by each valve

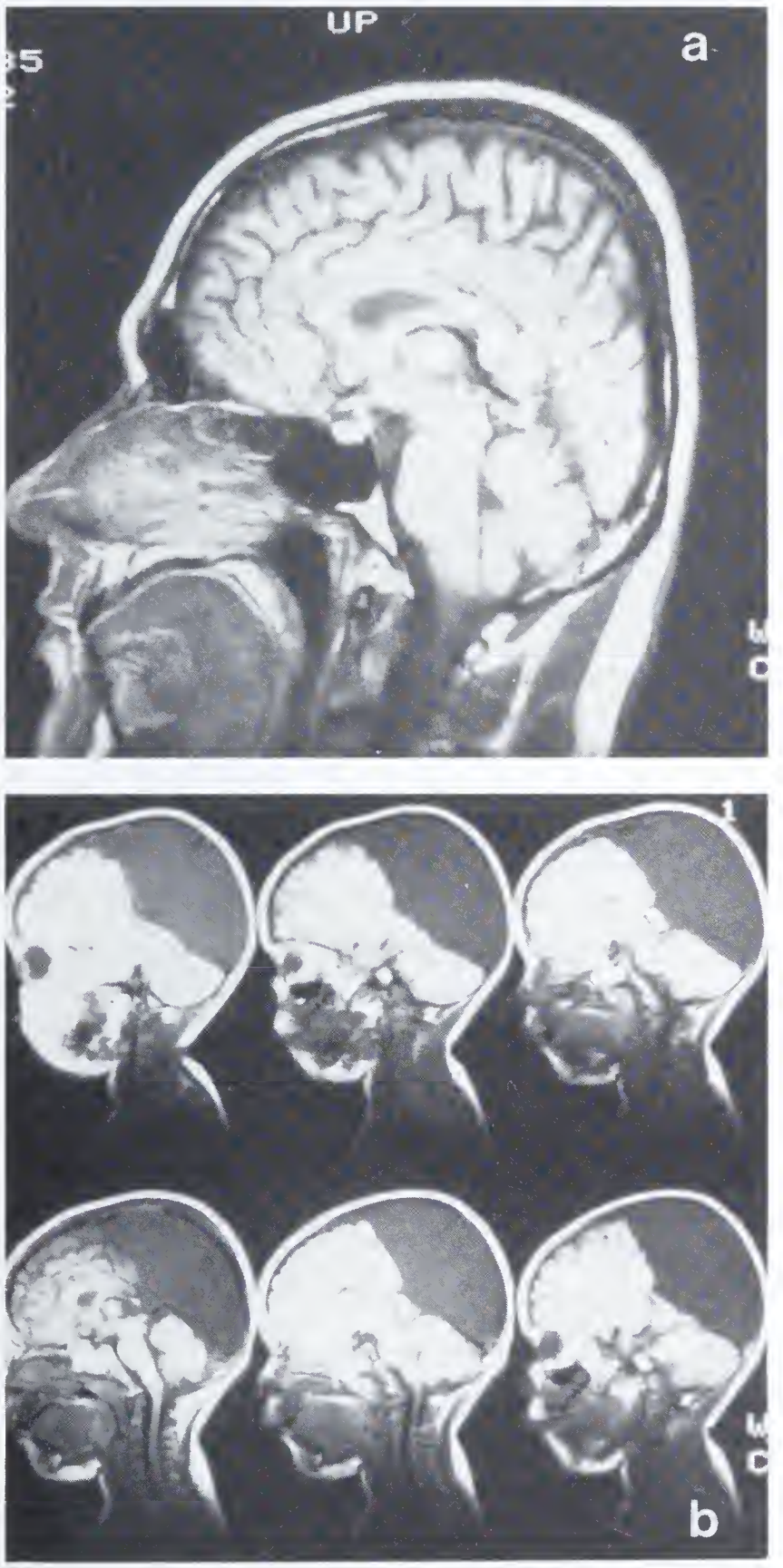

Figure 8: a) MRI sagittal section of the head showing details of the cerebrum, brain stem, and naso-oral soft tissues. b) Sagittal sections of a pediatric patient show an arachnoid cyst. c) Sagittal sections of another pediatric patient show a syringomyelocoele. (Photographs courtesy of Dr. Tolia, Department of Radiology, St. Michael's Hospital.)

can be differentiated and the severity of each lesion can be individually assessed without an invasive procedure. When prosthetic valves have been implanted, CDFI can distinguish between regurgitation through the valve and regurgitation around the valve. Intraoperatively, CDFI can be used to assess operative success before the chest is closed. An example of CDFI is shown on figures 9 and 10. The first figure shows a stenosed mitral valve and the jet of blood flowing through it which bounces off of the ventricular wall and then goes toward the apex. Some regurgitant flow can also be seen through the aortic valve. In the second figure, an eccentric regurgitant flow is seen through a prolapsed mitral valve. This may not have been picked up by conventional doppler techniques.

CDFI allows fast and accurate assessment of abnormal blood flow patterns. It provides the information for calculation of blood flow volumes. Currently, CDFI is just entering the clinical setting. As it becomes more widely used, it will probably replace conventional doppler techniques because of its accuracy, speed and ease of interpretation.

DUS and CDFI equipment varies from a price of $120,000 to $250,000 according to the number and types of transducers that come along with it.

Figure 12: CT scan of the patient in figure 11d. (Photograph courtesy of Quantified Signal Imaging Inc.)

Quantitative Electrophysiology

> "...For years the electroencephalogram (EEG) was the state of the art in neurophysiology representing the synchronized rhythms generated by the brain as it is functioning. Amplifiers developed in the 20's and 30's had made it possible for the electrical activity in the brain to be recorded non-invasively with electrodes placed on the scalp..."
>
> "...However, the EEG had to be subjectively 'read' using visual inspection of the analog wave forms, and because of the rapid real-time properties of the brain, the apparent variability in normal functioning individuals, and the complex changes that take place with development, the amount of 'data' that had to be taken into account simultaneously was overwhelming. Because of this, the medical sciences approached this tool with caution and the potential of the EEG for clinical diagnostics remained buried behind the conservativeness spawned by low reliability..."
>
> Herbert Kaye, Ph.D.

Quantified electrophysiology (QE) involves the input of the normal 20 lead EEG or signals from evoked potentials into a processing unit that plots, analyzes, averages and allows easy manipulation of data (figure 11 and 12). The distribution of various wave activities may be seen and changes in the distribution over time may be studied millisecond by millisecond. Applications in the area of seizure detection and location, the study of brain injury secondary to head trauma, localization and definition of cerebrovascular disease are forthcoming. Subtle dysfunctions of brain activity due to toxins and drug abuse, characterisation of genetic disorders, renal and liver dysfunction affecting the brain, Reye's syndrome, meningitis, dementias, learning disabilities, headaches and psychiatric disorders will all be further understood by using the QE technology. Evoked potentials literally enter a new dimension with 2D mapping of the various peaks and waves.

The images produced are clear and allow information to be obtained at a quick glance without the need to examine the encoded strips from each of the (as many as 20) leads. Scanning of sleep studies involving 8 or more hours of EEG output can also be done much more easily.

As a data base of characteristic QE patterns of pathological and normal brain function is built up, new EEG patterns (that elude diagnosis by human experts) may be compared to the QE data base to suggest similarities and to aid in diagnosis conclusions.

The full capabilities of QE have yet to be discovered. The field is very much in its infancy stage and the possibility for an accurate look at brain function at very low cost ($75,000) will make it indispensible in the future.

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A Case Study: Two Incurable Diseases Multiple Sclerosis and Schizophrenia

Virginia Wesson, M.Sc.
Brian F. Hoffman, M.D., F.R.C.P.(C)

Multiple sclerosis and schizophrenia are two chronic disorders which, individually, are not fully understood. Thus, it follows that still less is known about a possible connection between the two. This paper describes a patient who suffered from both multiple sclerosis and schizophrenia and addresses the possibility that they may be related.

Multiple sclerosis (MS) is a neurological disorder in which neurons throughout the central nervous system (CNS) become demyelinated.[1] Its prevalence is estimated to be 50 per 100,000 population.[1] It affects more women than men with a female to male ratio of approximately 3:2.[2 3] Its cause is not known but both environmental and genetic factors have been implicated. The importance of such factors is suggested by the observation that MS is more common in cold and temperate climates, persons of different races are not equally at risk for MS, and the disease tends to cluster in families.[4 5] It may be that there is a genetic susceptibility to MS but exposure to an environmental trigger is necessary for it to occur.[4]

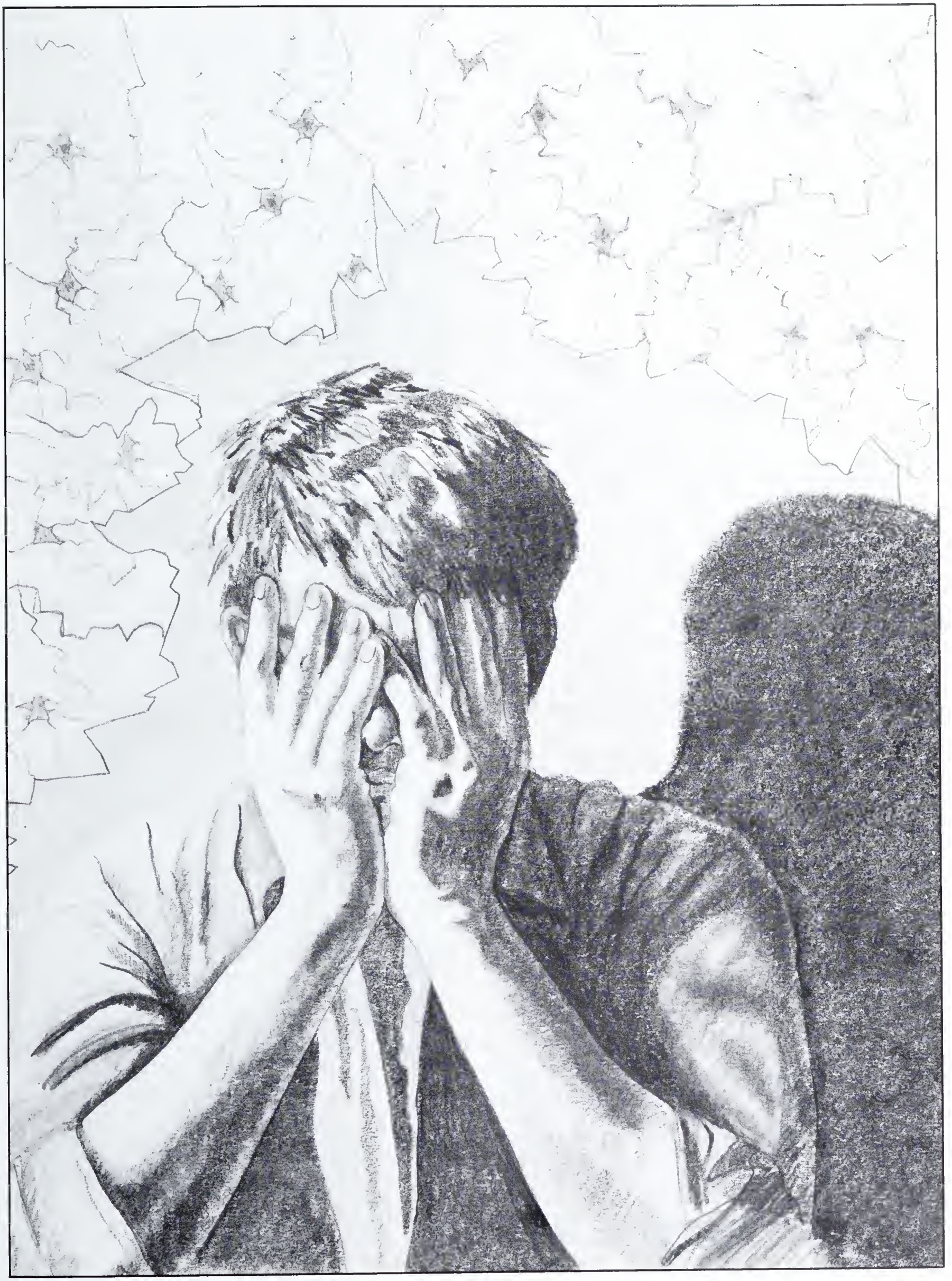
In MS, areas of demyelination are most commonly found in the optic chiasma and nerves, brain stem, cerebellum and the lateral and posterior columns of the spinal cord[6] and account for its clinical signs and symptoms. Visual disorders are frequently seen and may take several forms including optic neuritis, nystagmus, diplopia, internuclear ophthalmoplegia, and blindness.[6 7] Lesions of motor neurons produce many of the more obvious motor features of the disease such as weakness and spasticity.[1 6 7] Abnormalities of gait, incoordination and tremor indicate cerebellar involvement.[4 7 8] Many patients experience disturbances of sensation.[7 8] In addition to the physical problems encountered in MS, some patients suffer from psychiatric difficulties including depression, mania and anxiety,[9 10] as well as intellectual deterioration.[11 12]

The diagnosis of MS requires evidence of lesions in two anatomically distinct locations in the CNS at two different points in time.[13] Tests using evoked potentials may be used to demonstrate slowed electrical conduction in neurons, particularly in the visual pathways.[14] Slowed conduction, even in the absence of clinical symptoms, is evidence of demyelination of neurons. Other diagnostic tests include cerebral spinal fluid (CSF) examination which reveals little or no increase in total protein but a disproportionate increase in gamma globulins.[15] As proteins do not readily cross the blood brain barrier, these immunoglobulins are believed to be produced in the CSF.[15] When concentrated CSF from a patient with MS is examined by electrophoresis these proteins are observed as several bands in the gamma globulin region. This abnormal pattern is referred to as oligoclonal banding and is seen in greater than 90% of cases of MS.[16] The specificities of the oligoclonal IgGs are not yet known but a portion are thought to be directed against brain tissue.[17] The CSF of some patients with MS contains myelin basic protein, a product of myelin breakdown.[18] Its presence is felt to indicate that myelin is being destroyed.[18] Thus, some of the species of IgG present may be myelinotoxic antibodies.

CT scans taken during relapses are often normal but may reveal lesions particularly in the heavily myelinated areas of the brainstem and in periventricular regions.[19 20] Of all the tests described, oligoclonal banding is the most sensitive.[4]

At present, there is no curative treatment for MS. Therapeutic measures are directed at controlling symptoms and helping the patient manage daily activities.[6 21] The course of MS is quite variable. It may take a benign form with few relapses and complete remission between attacks.[8] More commonly, relapes occur every few years with residual deficits increasing over time.[1 4]

The second illness of interest is schizophrenia which is a psychiatric disorder characterized by severe ego disturbance, perceptual and thought disorganization and behavioral changes.[22] Its lifetime prevalence is estimated to be 1%, twenty times greater than that of MS. It affects men and women in approximately equal numbers[23] although men tend to be hospitalized more frequently and at a younger age.[24] Its cause is not known but it seems likely that it develops in genetically vulnerable individuals following exposure to an environmental factor. It is not known whether the environmental factor is biological or psychosocial. Vulnerability may be determined by physical factors such as abnor-



malities in dopaminergic pathways in the brain and/or psychosocial factors including social isolation and poor child rearing.[22]

The modern diagnostic systems, such as The Diagnostic and Statistical Manual of Mental Disorders (DSM-III), require that the individual meet several criteria for a diagnosis of schizophrenia including the presence of one or more types of bizarre delusions, mood incongruent auditory hallucinations or formal thought disorder of characteristic types. In addition, the patient must be 45 years of age or less at the onset of the illness, have experienced a deterioration in level of functioning, be free of bipolar and organic mental illness and mental retardation and show some degree of chronicity with at least 6 months of symptomatology. Diagnosis is based on a careful history mental status examination.

Treatment is symptomatic rather than curative. Neuroleptic medications are usually successful at controlling hallucinations, delusions and formal thought disorder. In most cases, long-term pharmacotherapy is required to manage symptoms and prevent relapse. In addition, social and vocational rehabilitation is necessary to reintegrate the patient into society.

Examination of the features of these two diseases reveals similarities which may suggest an association between them.[25] Their precise causes are not known but both may require a genetic susceptibility coupled with an environmental trigger.[5 22] Family studies in both MS & schizophrenia demonstrate that the siblings of patients are at several times the risk of developing the affected individual's disorder when compared to unrelated control subjects.[26 27] It has also been suggested that both are caused by a slow virus infection.[28]

MS & schizophrenia both develop more frequently in early adulthood, between the ages of 20 and 40 years.[25] Patients with either disorder experience a decline in quality of life and ability to function in society. Treatment of both conditions is designed to alleviate symptoms but does not halt their progression. Finally, both MS and schizophrenia have uncertain prognoses. Generally, their course is downhill but outcome cannot be predicted in the individual case.[4]

Despite the possibility that these conditions may be related, few cases in which they have occurred together have been reported. This report describes a chronic schizophrenic woman who subsequently developed MS. An attempt is made to address the possibility of a link between these two conditions.

Case Report

Mrs. E is a 38 year old woman with a 15 year history of classical schizophrenic symptomatology. She has suffered chronically from auditory hallucinations in which voices address her as well as comment on her behavior. Sometimes, the kind and caring voices of her parents were heard. At other times she heard the devil's voice speaking to her in a frightening and accusatory way. She has a history of bizarre delusions. When ill she believed her parents were in danger at the hands of "evil forces" and referred to a stuffed parrot that she carried around as Jesus Christ. She has been hospitalized on numerous occasions when, most commonly, non-compliance with neuroleptic treatment led to deterioration of her condition. She has been treated with a wide variety of neuroleptic drugs including fluphenazine, haloperidol, pimozide and fluspirilene, with only partial success. When taking medication, she was not psychotic but showed loosening of associations and was unable to live or work independently. She required anticholinergic medication to control the extrapyramidal side effects of her anti-psychotic medication.

At the time of a recent admission, she was delusional, experiencing auditory hallucinations and felt that she was receiving messages from the television. Marked tangentiallity and circumstantiality of her speech were evident. She had neglected her neuroleptic drugs for some months. Therefore long acting neuroleptics, fluphenazine 25 mg given in weekly IM injections and haloperidol 5 mg po every 4 hours, were prescribed. It was during this admission that neurological symptoms were first recognized.

Gross tremor of the upper limbs and marked gait disturbance were observed. She was seen to suffer from cognitive slowness, depression, akinesia and occasional urinary incontinence. It was initially felt that these could represent drug-induced side effects. Neuroleptic medications were discontinued and diazepam was prescribed to reduce the tremor.

These measures seemed to alleviate the tremor and gait abnormalities. To treat her thought disorder, low dose neuroleptic treatment with fluspirilene and pimozide was begun without aggravation of her physical symptoms. She was discharged to a boarding home on fluspirilene 6 mg IM weekly, pimozide 2 mg as required for agitation and diazepam 10 mg as needed for sleep.

Four weeks later, she was readmitted due to a breakdown in her living arrangements and an exacerbation of her psychiatric illness. Although she was grossly psychotic, her physical condition had shown little change since discharge. Notably, her tremor and gait disturbance persisted despite the low level of neuroleptic medications. In addition, slight buccal-oral movements suggestive of tardive dyskinesia were present. A neurological consultation was requested.

On enquiry, Mrs. E reported a history of tremor of both hands, unstable gait, physical weakness and episodes of urinary urgency and incontinence of about one year's duration. All of these symptoms had improved with reduction of neuroleptic dose. She denied blurred vision, diplopia, dysarthria, seizures or sensory change. Physical examination revealed signs of neurological dysfunction. Nystagmus on lateral gaze was demonstrated. Symmetrical loss of muscle bulk with intermittent cogwheeling and prominent tremor of the upper limbs were noted. Power was good for all muscle groups with the exception of the wrist extensors and knee flexors which were weak. An intention tremor, greater on the left than the right, mildly impaired coordination bilaterally and unsteady gait with a wide base were evident. There was decreased vibration sense in the left lower limb below the knee. Light touch, proprioception, temperature and position senses were

normal. She had an upgoing toe on the right side. There was no improvement in her symptoms when the neuroleptics were completely discontinued.

In summary, the examination demonstrated localizing signs of pyramidal, extrapyramidal and cerebellar disease. The possible causes included: demyelinating disease; posterior fossa mass; possibly a tumour or aneurysm; vascular infarct due to embolism or vasculitis; or drug-induced side effects. The diagnosis of MS was made on the basis of the history and physical examination and confirmed by oligoclonal banding revealed by electrophoresis of CSF. The CT scan was normal.

Discussion

Many studies have shown that depression occurs more often in MS than in other neurological disorders of comparable morbidity.[29 30] The reason for this association is not clear but it has been proposed that depression may be a part of the constellation of problems which make up MS;[11 29 30] a psychological reaction to MS;[31 32 33] or occur independently and unrelated to the neurological illness.[29]

The association of MS with psychiatric disorders other than depression is less clear although the authors are aware of several cases of bipolar affective disorder and mania occurring in MS patients even when steroids have not been used.[11 29] While unproven, a link between MS and schizophrenia has been suggested by their shared characteristics. A review of the literature concerned with these two disorders helps to clarify the connection.

Case reports exist in which a patient presented with what appeared to be schizophrenia but was later proved to be MS. Two such patients have been described by Matthews.[7 34]

The first patient was a woman who presented with rapid and repetitive speech, refusal to eat and unwillingness to do anything but remain in bed. She was admitted to a psychiatric hospital where she developed bizarre movements including rocking of the body, cycling of the legs and head banging. A diagnosis of schizophrenia was made. Treatment with chlorpromazine was ineffective. An organic cause for her condition was not suspected until she developed seizures following electroconvulsive therapy. Her problems resolved after a short course of phenytoin and MS was not diagnosed until three years later when she developed optic neuritis.

The second patient presented with symptoms suggesting schizophrenia including apathy, depression, inability to care for herself and refusal to eat or speak. She swung between expressionless inactivity and loud outbursts of shouting, kicking and back arching. She answered questions of general knowledge in a bizarre way. There were signs suggestive of MS including elevated CSF protein and lymphocytes, ataxic gait, hyperresponsive tendon reflexes in the lower limbs and positive Babinski responses bilaterally. Her illness cleared within three months with steroid therapy. No diagnosis was made until two years later when bilateral delayed visual evoked potentials and optic atrophy were noted. In both cases, the original episode was felt retrospectively to be MS not schizophrenia.

There are also a few reports of patients in which schizophrenia and MS were felt to exist independently of each other. One such patient was a chronic schizophrenic who subsequently developed MS.[35] Another was felt to have developed the two disorders at the same time.[36] A third patient was hospitalized for seventeen years with schizophrenia characterized by violent behavior, auditory hallucinations and paranoid ideation before clinically evident MS developed and was diagnosed.[7] Galleneck and Kalinowsky reported two patients with MS who later developed schizophrenia which they felt was unrelated to their original condition.[37]

Some believe that MS itself may be the cause of the mental changes seen in this condition. Salguero et al described a case of an eight year old girl who presented with MS accompanied by bizarre psychotic features. They attributed her mental changes to multiple lesions throughout the brain, including the limbic system, ventromedical hypothalamic nuclei and hippocampus.[38]

The small number of these case reports seem to suggest that MS and schizophrenia are rarely causally related. Nevertheless, it has been suggested that factors which increase the risk of MS such as geographic location, genetic makeup and family history also increase the risk of schizophrenia.[25] It may be that MS and schizophrenia represent two presentations of the same underlying pathological process. The form which the disease takes in any patient may be determined by individual but unknown factors. But it must be noted that only very tenuous evidence exists at present to substantiate the theory.

In the case under discussion, consideration was given to the possibility that Mrs. E had suffered from MS for fifteen years and had never had schizophrenia. However, a review of her history, including careful scrutiny of her symptoms and response to medication, leaves little doubt that she has schizophrenia and that it both predates, and exists independently of MS. What is not clear is when MS began and what part of her present behavioral and emotional symptomatology is due to MS and what part to schizophrenia. What is apparent is that it will become increasingly difficult to differentiate the two as time goes on. MS is quite likely to affect her cognitive function, thereby altering her psychiatric condition. However, the relative importance of the two in her deterioration will be unclear. Regardless of any possible association between MS and schizophrenia, their coexistance in one patient presents a formidable challenge to those who care for her. It is difficult to devise a care plan that is ideal for both disorders. A concerted effort by both the patient and those caring for her is necessary to ensure successful management of this case.

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Anterior Mediastinal Mass

*Susan Babensee, Robin R. Gray, M.D.,**
Robert H. Hyland, M.D. and Donald P. Jones, M.D.**

A previously healthy, 79-year-old Hungarian woman presented to her family doctor with a two-month history of increasing fatigue, weight loss and weakness.

She was a non-smoker and denied dyspnea, chest pain, cough, sputum production or hemoptysis. There had been no fever or night sweats and she had no other complaints on full functional enquiry. Her past medical history included a cholecystectomy and an eight-year history of hypertension.

The physical examination was normal except for the cholecystectomy scar and mild hypertension. No masses were found. Her neurological examination and her abdomen were normal.

Routine blood chemistry and hematology were also normal. However, her chest x-ray (figure 1) showed a 5 cm. diameter mass anterior to the left hilum and obliterating the silhouette of the main pulmonary artery (PA) segment. The left PA is clearly seen through the mass (hilum overlay sign) indicating that the lesion is not arising from the left PA.

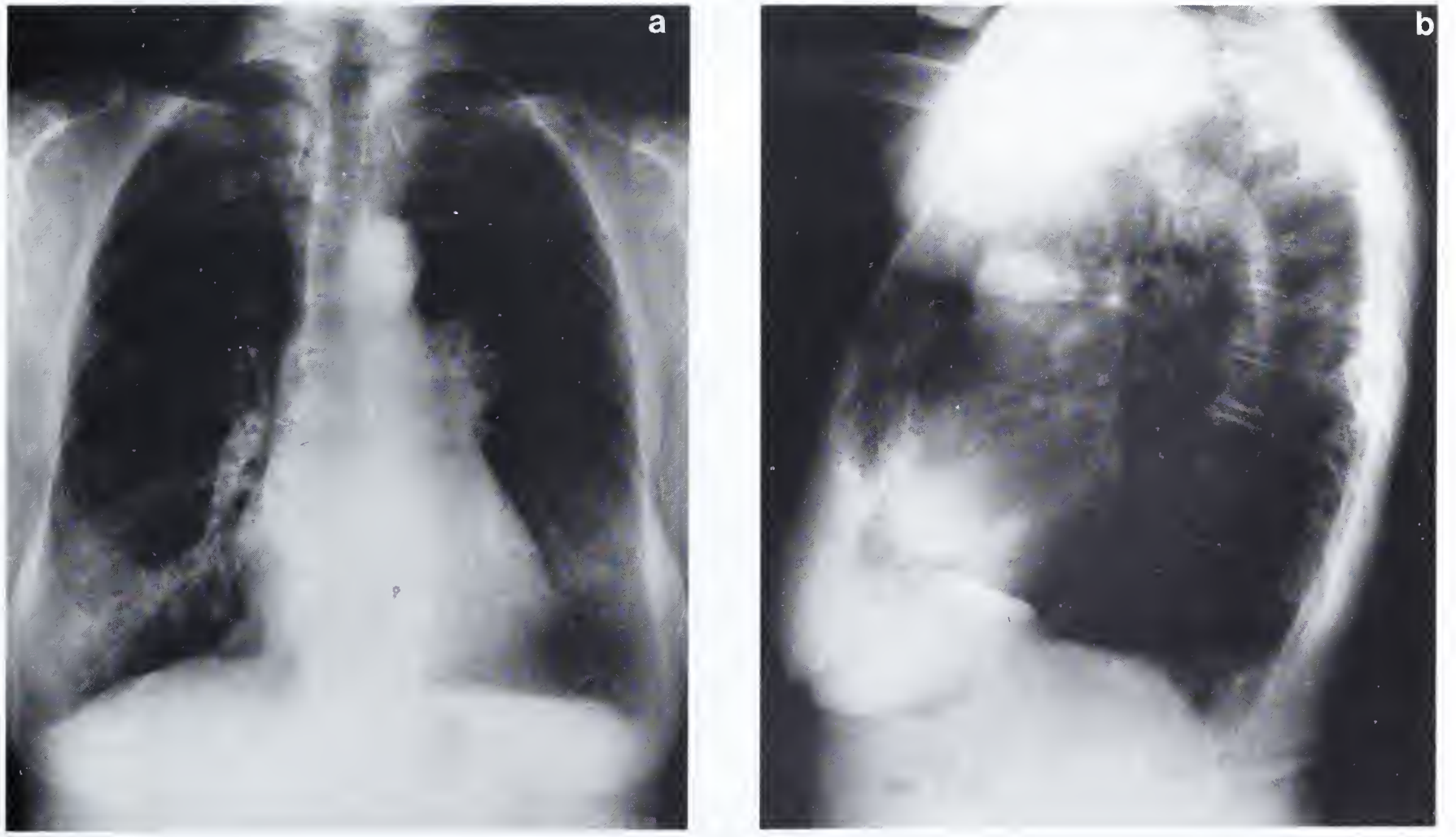

Figure 1 A & B: PA and lateral views of the chest show a 5 cm. diameter mass in the anterior mediastinum overlying the left hilum.

**Departments of Radiology, Medicine and Surgery,*
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She was admitted to The Wellesley Hospital for investigation of her anterior mediastinal mass. A dynamic computed tomography (CT) scan (figure 2) showed that this lesion did not arise from the main PA. It was, however, fairly vascular with its feeding arteries filling during the systemic arterial phase (figure 2A). There was no fat, calcium or bone density in the mass on CT (figure 2B).

No abnormalities were found on ECG or bronchoscopy. An EMG using the median facial nerve was normal.

A fluoroscopically-guided percutaneous transthoracic needle biopsy was performed and yielded diagnostic material.

What is your diagnosis?

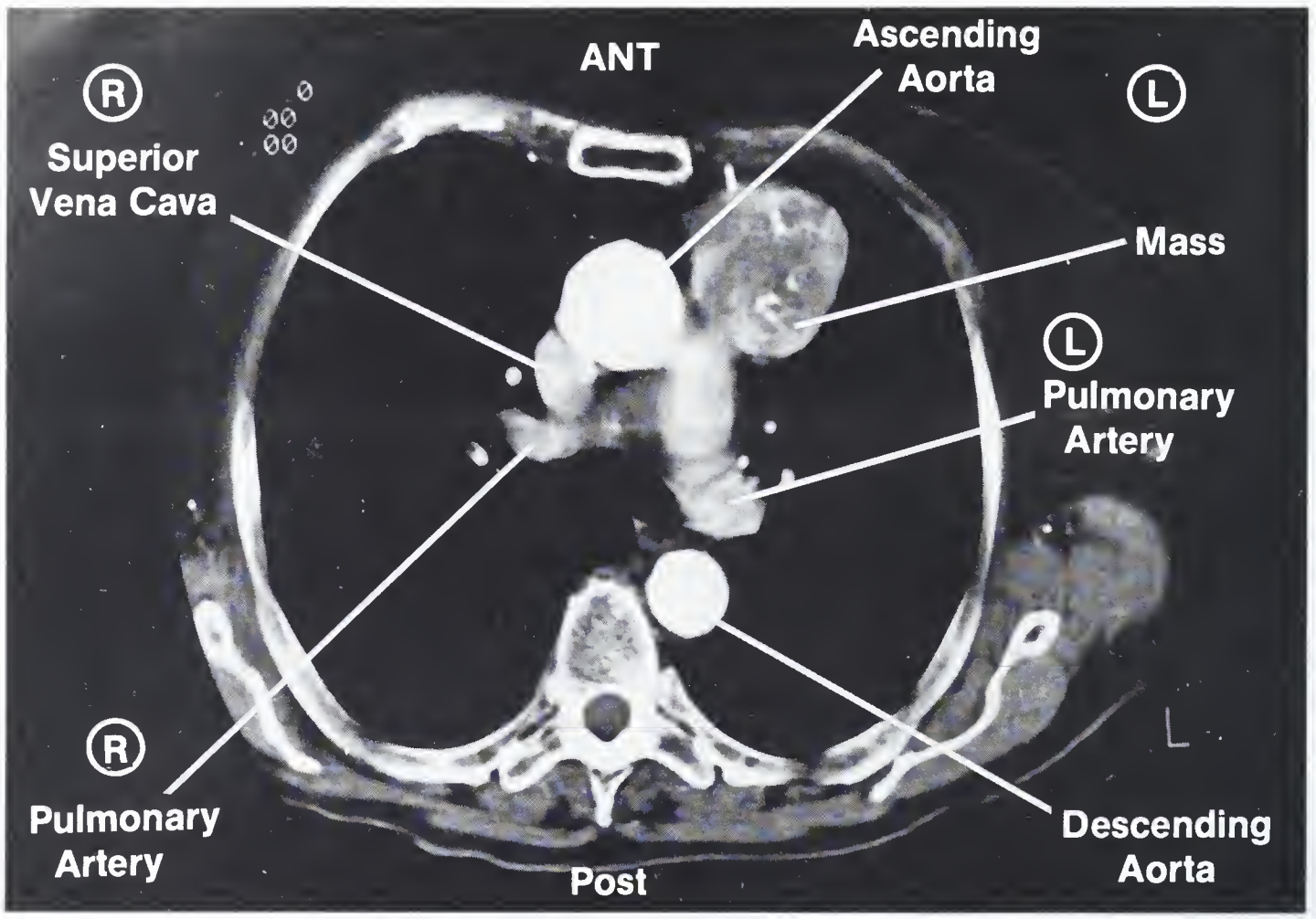

Figure 2A: A selected film from a dynamic CT scan shows that the mass is not arising from any vascular structure, but does have a fairly high degree of vascularity filling synchronously with the aorta (i.e. systemic blood supply).

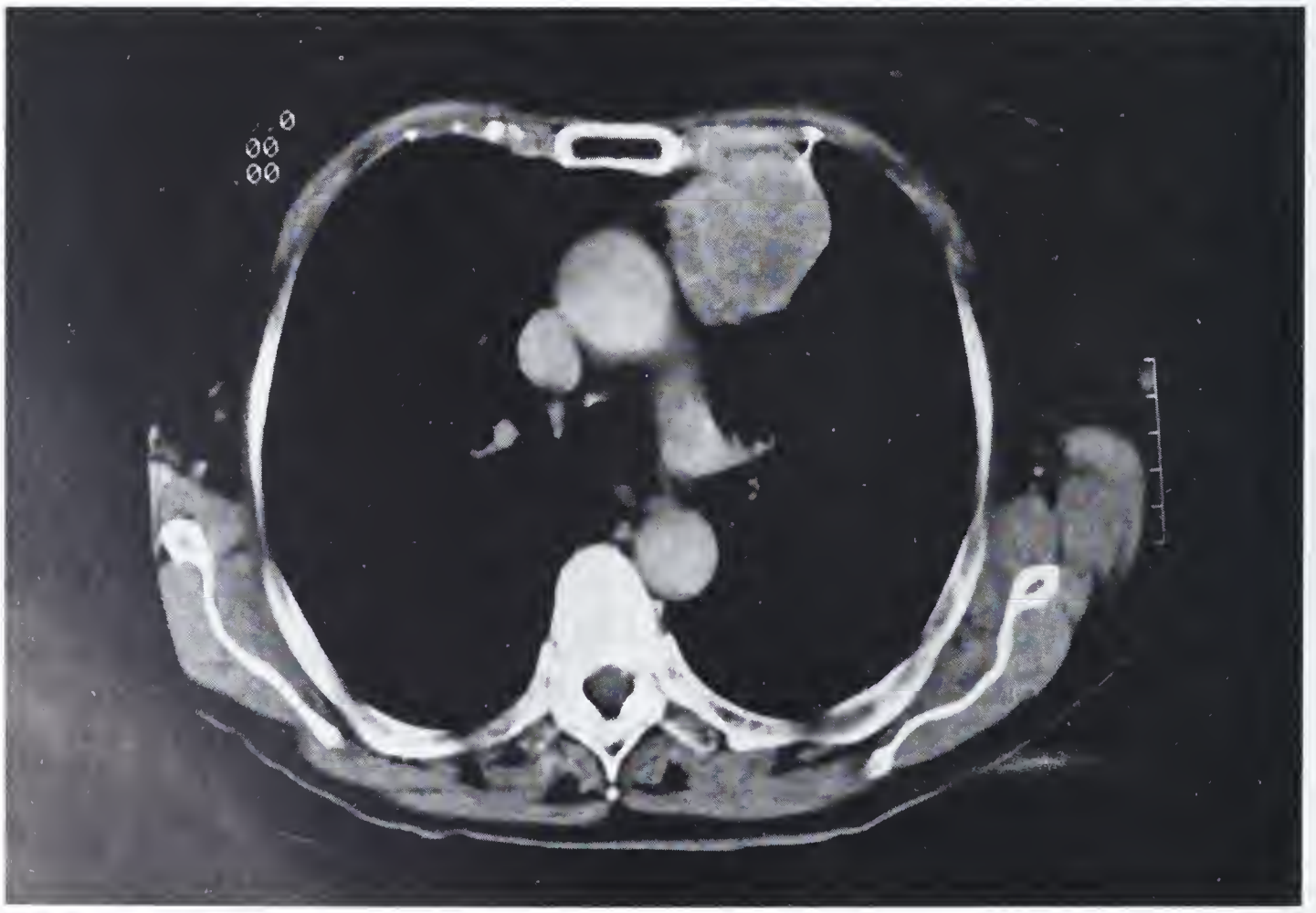

Figure 2B: A CT scan prior to contrast injection shows a soft tissue density mass without calcified, fat, or cystic components.

Diagnosis

The needle biopsy specimen was adequate for histological examination and was compatible with a thymoma of mixed epithelial-lymphoid type. Through a median sternotomy, a 9 x 5 x 5 cm thymoma was removed from the left anterior mediastinum. This tumor was encapsulated and on pathological examination was a lympho-epithelial thymoma with areas of spindle cell aggregation. All thirteen regional nodes removed with the thymoma were negative.

Discussion

Thymomas, neurogenic tumors and congenital cysts are the most common primary mediastinal masses, comprising 60% of all lesions.[1] Thymoma is the most common anterior mediastinal mass with a peak incidence between 40-60 years of age, with an equal male:female ratio.[2]

Thymomas generally present in one of the following three patterns. The first presentation includes signs and symptoms of invasive disease. A thymoma spreads either locally or by transpleural hematogenous or lymphatic seeding, resulting in such complications as venous or occasionally tracheal obstruction or pleural and pericardial effusions.[3] Alternatively, it may present with symptoms of associated systemic disease. Forty to fifty percent of patients with thymoma present with or develop myasthenia gravis, and about 5% have other autoimmune disease with or without myasthenia gravis, such as red cell aplasia, hypogammaglobulinemia, Cushing's syndrome, SLE, pemphigus vulgaris, Sjogren's disease, and giant-cell myocarditis. However, overall, approximately 50% are asymptomatic or have nonspecific complaints similar to our example.

Symptomatology has been shown to have some predictive value in determining malignancy: approximately 90% of asymptomatic patients are found to have benign lesions, whereas half of symptomatic patients have malignant disease.[1]

The chest x-ray (PA and lat) may be the most useful diagnostic tool in the investigation of mediastinal masses, especially those which are asymptomatic. By localizing the lesion within a particular mediastinal space, and knowing the boundaries and contents of each, one may be able to narrow the differential diagnosis of the mass (table 1) and determine what further investigations are required.

To review, the mediastinum is that space in the thorax between the two pleural cavities, bounded superiorly by the thoracic inlet and inferiorly by the diaphragm. The anterior compartment lies between the sternum and pericardium, and contains the thymus and lymph nodes. Within the middle compartment lie the heart and pericardium, ascending and transverse aorta, superior and inferior venae cavae, trachea and hila, phrenic and vagus nerves, brachiocephalic and pulmonary arteries and veins, and lymph nodes. The posterior mediastinum lies between pericardium and vertebral column, and contains the esophagus, descending aorta, thoracic duct, azygos and hemiazygos veins, the sympathetic chain and lymph nodes.[4]

Table 1
Mediastinal Masses by Compartment

Anterior	Middle	Posterior
thymoma	lymph node enlargement	neurogenic tumor
germinal cell tumor	lymphoma	esophageal lesion
lymphoma	metastases	foramen of Morgagni hernia
intrathoracic thyroid carcinoma	granulomatous disease	lymphoma
parathyroid adenoma	bronchogenic & enterogenic cysts	paravertebral abscess
lipoma	pleuropericardial cyst	meningocele
lymphangioma	enlarged mediastinal vessels	
aortic aneurysm	enlarged pulmonary arteries	
	coarctation of aorta	
	aortic aneurysm	

Further investigation of the mediastinal mass may include tomograms and/or CT. Computed tomography has been shown to be highly accurate in detecting signs of malignancy in thymoma, which include metastases and/or invasion beyond the capsule, and is especially effective in detecting pleural implants, pericardial tumor, and invasion of pulmonary parenchyma.[5,6] In the investigation of the mediastinum in patients with myasthenia gravis (of whom 8-20% have thymoma) CT was found to be sensitive in distinguishing thymoma from thymic hyperplasia in those patients greater than 40 years of age but inconsistent in those younger than 40 years.[7,8] Distinguishing solid from cystic lesions by CT may not be particularly useful since thymomas may become cystic with degeneration, and since teratomas may be solid, cystic, or both.

Echocardiography and angiography may be used to determine whether a vascular lesion is simulating an anterior mediastinal mass on chest x-ray. Barium studies and myelography may be used to rule out enteric and neurogenic lesions respectively.

Needle aspiration biopsy is utilized to identify histology, and although cellular morphology is an unreliable index of malignancy in thymoma[1,9]; more recent studies have shown correlation between degree of differentiation of tumor and prognosis.[2] Mediastinoscopy and anterior mediastinotomy may secure a histologic diagnosis if aspiration biopsy is inconclusive.

Management of thymoma requires an aggressive surgical approach since surgical exploration and pathologic section are required to confirm a CT diagnosis of malignancy and since benign tumors may enlarge to compress mediastinal structures, cause hemorrhage or rupture.[1] Most surgeons prefer an anterior approach because this affords greater freedom should signs of malignancy become apparent. Review of the literature suggests there are, as yet, no good studies concerning benefit of pre-op and post-op irradiation. However,

post-op irradiation is frequently used in those patients found to have malignant thymoma.[10]

Invasiveness is a major prognostic factor in thymoma: patients with resection of a non-invasive tumor have an 85% 5-year survival contrasted with 50% in invasive thymoma.[2] Previously, it was believed that associated with myasthenia gravis adversely affected prognosis[9], however, this has been disputed in more recent studies.[2,11] Recurrence of myasthenia gravis or persistance following thymectomy has been reported to be as high as 20%.[10]

In summary, although thymoma is the most common anterior mediastinal mass, it is an uncommon tumor with the incidence varying with the population studied. However, familiarity with mediastinal anatomy and use of selected diagnostic tests can result in a fairly accurate assessment. The treatment of choice for most mediastinal masses other than lymphoma is surgical.

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Thoughts on Medical Education

Stephen Ivor Esses, M.D.

Assistant Professor, Faculty of Medicine, University of Toronto

As a preface to this article, I would like to inform the reader that the author is a Toronto trained orthopaedic surgeon. His undergraduate degree, medical degree, masters degree, internship and orthopaedic training were all carried out in this city. Although perhaps it may be argued that his education has been geographically limited, he has always considered himself more intellectually open minded than most. Over the past two years, he has travelled extensively through North America, the Orient, and Europe. During this time, the author has re-evaluated deficits and assets of his training. In particular, he has realized, with concern, the lack of emphasis in North American Medical Schools and training programs on alternative treatment modalities. It is this issue that he wishes to address.

As medical students, we are indoctrinated not only with science but also with morals, opinions and approaches. This non-factual component to our education reflects, for the most part, the ideas and thoughts of our teachers. Although our formal training officially ends after four years, the process of indoctrination carries on unabated. The people around us practice medicine in a particular way. They treat disease X with regimen Y. To use some other therapeutic modalities is considered inferior and still others considered dangerous. We become increasingly conditioned to follow the same approaches as the colleagues around us and eventually a group pattern is established. Disease X is always treated with regimen Y... condition R with S, B with C, etc. This may well be an acceptable standard of practice but it tends to discourage alternative approaches and inhibits the stimulation of new ideas. It certainly breeds a provincial atmosphere. Although we continue to read about alternative methodologies and are aware that there are people elsewhere who do things differently, our attitude is more than a bit xenophobic.

During my residency in Toronto, we often had visitors, not only from other parts of North America but from around the world. At that time, it seemed both natural and appropriate that we demonstrated to them our techniques of handling certain problems. They were seldom asked to expound on their approaches to various orthopaedic entities. In retrospect, I think this was due to two reasons. First, there was a tacit agreement among the Toronto crowd that our approach was obviously the best. In view of this, asking our visitors for information was more an issue of etiquette rather than a quest for knowledge. Second, and related, the atmosphere for intellectual stimulation was not present. Most of the physicians were quite content to continue doing what they had been taught, even though, perhaps their training had been completed decades earlier. I have been fortunate in recent years to visit cities and institutions where there is a genuine interest in knowing not only what is done locally, but what is done in every other part of the world. This provides a basis for discussion, criticism, and ultimately, improvement. We should not delude ourselves into thinking that any of our therapeutic modalities are perfect. Each can be improved upon. It is the smug contentedness of the physicians around us with the way they practice that blocks our realization of improvement.

All of us make a choice, either consciously or subconsciously at some time in our professional careers as to what route our intellect will travel. We can, like so many around us, reject and ignore alternate treatment regimens. We can be satisfied with continuing to practice what our teachers taught us no matter how long in the past this was. On the other hand, we can act as perpetual students and continue to investigate and contemplate all various options available. In this way, although we may occasionally make mistakes and encounter complications, improvement may ultimately be found in our practice. Apart from providing benefits for our patients, this approach yields an important secondary personal gain. It ensures that our professional career is constantly evolving. I believe that this dynamism is integral to enjoyment. Personally, I hope that my treatment for displaced subcapital hip fracture is different in the year 2000 compared to now. Medicine is a fantastic field. A cursory look at any of its subspecialties will demonstrate the immense progress that has been made during the past decades. I think it important to be part of that group of doctors who have helped, not hindered, those advances.

Reading is one way of expanding our horizons, but unfortunately much of what is written is B.S. (bold speculation) and very little is fact. Thus, travelling remains an ideal avenue to seeing, learning and evaluating techniques and approaches different from our own. I have been impressed, in talking with older surgeons, that many technical advances have been brought to Toronto only because these individuals visited other centres. When these physicians heard that perhaps a new technique was either interesting, innovative, or proving to be effective, it was they who personally went to view and assess for themselves. Although tra-

velling is encouraged in post-residency Fellowships, enthusiasm for it seems to wane as one gets farther and farther from their certification. People today argue that the need for travelling has been obviated because of the dramatic increase in available medical literature. I find this a reflection of their misunderstanding. Reading about a procedure and seeing it performed by its proponents are two distinctly different entities. There can be no substitute for seeing something first hand as well as examining patients so treated.

The world is becoming a smaller and smaller place and there is no question that the medical community now has no genographic restrictions. The conditions are ripe for all of us to benefit from the technological advances which have made international communication so easy. I hope that we take full advantage of this opportunity. I believe that it will further the field of medicine, improve our international relations, and ultimately result in improved patient care.

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BOOK REVIEWS

Battles of Life and Death

by David Hellerstein, M.D.
Houghton Mifflin Co., Boston, 1986. 264 pages.

Battles of Life and Death is an account of Dr. David Hellerstein's experiences from his clerkship to his residency in psychiatry. Fourteen vignettes are presented describing how these incidents changed Dr. Hellerstein's perception of the medical field and his own role as a medical practitioner.

These accounts are both poignant and relevant to the thoughts that every medical student has at various stages of his/her education. The first chapter is the most touching. It describes the struggle of Cha-nan, a young Vietnamese woman with acute myelogenous leukemia who fights off the disease, only to be overcome by a side effect of her treatment (aplastic anemia). Hellerstein is able to offer Cha-nan only compassion while he deals with the issue of efficacy of chemotherapy in cancer treatment. In a common medical scenario, Dr. Hellerstein realizes that Cha-nan is past the point where she can be saved and wonders whether the use of chemotherapy is justified. Such moral dilemmas naturally coloured Dr. Hellerstein's outlook on medicine. When asked if he feels the glory of fighting to save lives, Hellerstein replies, "I hadn't felt that (glory), only the horror of fighting decay on multiple fronts; and the occasional victory attained only partial, a matter of delay."

Hellerstein's writing style is clear and concise. He is effective in conveying to the reader all his emotions and thoughts about the complex issues with which he deals. This creates a strong sense of pathos between the reader and the author. Throughout the book, Hellerstein emerges as a very likeable, sensitive man who struggles against bureaucracy, underfunding and the tragedy that is a part of every day life in medical institutions to convey a sense of compassion to all his patients.

Battles of Life and Death however, poses many questions and offers few solutions. Many of Hellerstein's patients leave his care with grave prognoses or unstable conditions, never to be heard of again. The reader, and seemingly the author, remain in the dark as to the outcome of these patients' treatments. As well, the issues Hellerstein raises regarding the ethics of the practice of medicine, although complex, are left unresolved. If, in writing this document, Hellerstein was able to excise his own ghosts and find the solutions to these problems himself, he does not convey this. It is possible that Hellerstein's solution is to encourage others to confront these issues. In this regard, **Battles of Life and Death** is an in-depth exploration into medicine's grey zone, where nothing is very easy or very correct, but everything is dead real.

Mohamed Khaled, 8T8

Examination Medicine (A Guide to Physician Training)

by Nicholas Talley and Simon O'Connor
Williams and Wilkins-Adis Pty Limited, Baltimore, 1986. 234 pages

This paperback from "Down Under" is written by two senior residents for those who are taking oral examinations in Internal Medicine. Drs. Talley and O'Connor's approach travels well, so that students in Canada will find this a valuable review text.

Initially, the authors describe the requirements for becoming a Fellow of the Royal Australasian College of Physicians. It is interesting to note that in Australia it is believed that writing exams 'may create situations that interfere with the postgraduate training of medical graduates and render the examination counterproductive.' This book reflects this attitude. Hence, I would speculate that for U of T students, clerkship is the upper limit for use of this book.

Be that as it may, tips for success on oral exams are plentiful and practical — do not believe everything the patient says; this is not the time to demonstrate eccentricity in apparel. Additionally, common sadistic cases are provided such as the notorious glass-eye-fundoscopic exam. Don't laugh — it could happen to you.

Examination Medicine is divided into long and short cases (conditions) commonly seen in orals. Each condition has a list of specific questions for diagnosis, management and complications. Pertinent findings on physical examination are listed and depicted with cartoons. Suggested investigations and treatments are given. Here, Canadians may encounter some discrepancies between this book and their studies. For example, every U of T grad worth his/her salt knows that the Kveim test for sacoid is an esoteric test at best. As well, the rheumatology section does not cover the shoulder joint (a favourite at U of T). However, this is more than compensated for by a generous neurology section. The authors have correctly assumed that the cerebrum poses special problems for medical students.

Examination Medicine is concise and well organized. It provides the nitty gritty information needed to get through oral exams. Armed with this book, students should feel confident enough to approach orals with the correct attitude. An oral should be a learning experience as well as an evaluation.

Janis Miyasaki, 8T8

Physical Signs: Hamilton Bailey's Demonstrations of Physical Signs in Clinical Surgery, 17th Edition.

by A. Clain (Ed.).

I.O.P. Publishing Ltd., England, 1986. 622 pages.

Fig. 13.3 Page 141

The first edition of this book was published in 1927, nearly 60 years ago. This in itself suggests that the book is useful to the students for whom it is intended. However, the present edition has been reviewed and updated by the present editor. The purpose of the book is to demonstrate to medical students and junior doctors the physical signs and relevant examinations associated with conditions requiring surgical intervention. This task is accomplished using clear text and many photographs, both black and white, and colour.

The book is logically laid out. The first section, consisting of five chapters, discusses general topics. The remaining six sections cover the body from head and neck to lower limb. There are also appendices for special topics such as the newborn, or signs in tropical disease. The chapters themselves are also well laid out. Almost every page has at least one photograph or diagram —there are 999 in total in the book. Headings referring to a specific area of the body, major signs, examinations, processes, or diseases are given in heavy type. Specific subheadings under the major headings are also set in boldface, or in italics, and are described in detail. Detail greater than what is needed by most junior doctors or students is given in smaller type than the standard text.

The photography is excellent, with all the photographs being referred to in the text, and also labelled with a brief, clear, description of what is being shown. The photographs depict examples of many pathological conditions — frequently dramatic — or the method of examining the region under consideration. A few illustrations are of examinations other than those possible at the bedside, for example, reproductions of X rays, but the vast majority of the examinations depicted require only hands and such equipment as a tongue depressor or pen light.

Finally, there is a large index, which not only lists the clinical signs included in the book, but also, as a series of subheadings, lists the specific diseases that the signs are associated with.

Some of the finer points of the book are also worth noting. The most useful of these are the footnotes which give the Latin or Greek roots and translation for many medical terms — a practice which often makes it easier to associate the technical term with the observed sign. Ptosis, for example, is Latin for "fall", and refers to the fall of a drooping eyelid. Also useful are the short explanatory notes on terms that may be unfamiliar to students. Somewhat less helpful generally, but still worth noting, are the brief biographical notes on the individuals who have given their names to eponymous diseases, or who are of particular importance in the history of a disease.

In summary, this is not a book that one would settle down with and read from cover to cover. However, as a guide for students beginning their work in clinics or on the wards, it would be invaluable. Photographs are the best substitute for actual clinical experience which, for many rare diseases, may not be obtained for many years. In **Physical Signs**, Dr. Clain has compiled an excellent and convenient reference book that I would recommend to any medical student or postgraduate.

Catherine Birt, 8T9

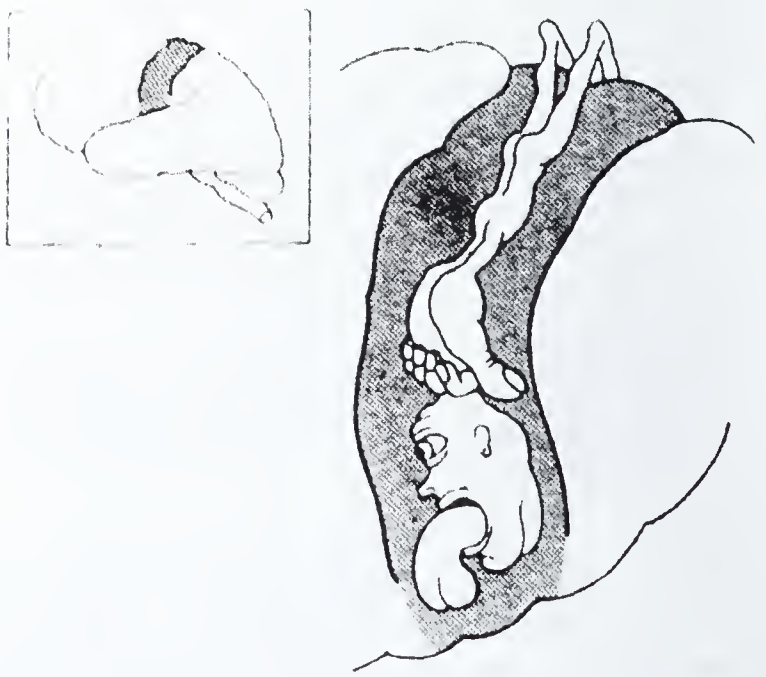

Fig. 6.18 Page 64

Dead Faces

Dead faces
should be
old faces
grinning that mischievous grin
that tells
of times
and tales within

That say
their time
has come at last
"fear not
we have
enjoyed the past"

Young faces
in death
show great despair
and warn
us all
to be aware

Enjoy
and love
the time, each friend
for no one
knows
when comes the end

Young faces
sleep with peace
in your new world of prayer
we will
heed well
your message to beware

For we think not poorly
of the dead
But remember well what
they have said

Suzanne Shephard 8T9

Manufacturing is not perfect

Screaming its circuits off at
three o'clock on Sunday morning,
a defective chip burning its insides,
the delirious computer sees
supersonic missles searing the sky closer and closer -
it prints messages faster and faster
relayed to the President
still half-asleep on his bed in the dark
who decides -

Brett Campbell

Ah, but for that Moment Lost

Ah, but for that moment lost —
Which no measure of regret can alter.
It's wisdom gained only at a cost.
When too late without falter
The realization dawns
That more should have and once could have been done.
Still this ruse of Time is not seen by pawns
Caught beneath the present sun.
In haste words heedlessly fly
At those lesser beings who extend their hand
Not to worship self-made temples nor lie,
But to find a human land.
Some never learn the trick of what really matters,
Nor why one day their bright star stands still and shatters.

Yvonne Opalinski 9T0

A Special Day

Scott Berry 9T0

The old woman sat alone, as usual, the table in front of her cluttered with plastic vials of generic drugs. Her eyes had been ravaged by glaucoma and one was clouded with cataracts. The neatly typed white labels on each bottle seemed to mock the eyes the contents were supposed to help. These pills and solutions were important parts of the woman's life not only because of the questionable relief they provided for her ailments, but also because their use formed the major events of her day.

However, today was no ordinary day. Not only was it Christmas day but it was also the woman's ninety-third birthday. Clearly this called for some break from the normal routine, clearly this was a day to let out the bird. The bird, a green budgie, sat in a shiny brass cage in a corner of the small room. He was the lady's only constant companion. They had spent many years together but the woman's affection for the bird could not in her eyes, be returned. In fact, she sensed something in the bird's bearing which suggested that he hated her. She often wondered whether birds were capable of such emotions. But, it was a special day, and as was the custom on such special days she would let out the bird to fly around the apartment.

The bird's actions were somewhat out of the ordinary that day though. After he was let out of the cage he came to perch on her shoulder and unabashedly gave her two pecks on the cheek. Some, perhaps the sentimental, would have called them kisses. This unexpected surprise was not the only one of that day though. On the way to the bathroom the woman slipped, falling and hitting her head on the wall.

The landlady who came to check on the old woman every day panicked when she found her unconscious. However, even when she had calmed down enough to call an ambulance, she was too agitated to notice the bird was out of the cage.

The lady was able to return home from the hospital the next day. She certainly wasn't prepared for what she found. The bird's body lay stiff and lifeless below the solitary window in the room. He had obviously been lured by the illusory freedom which the window offered but had been destroyed by something which was not as it seemed. But at least one illusion had been quashed by the bird before he died. He had let his friend know he did not hate her, and she would always be comforted by the fact that he had said goodbye.

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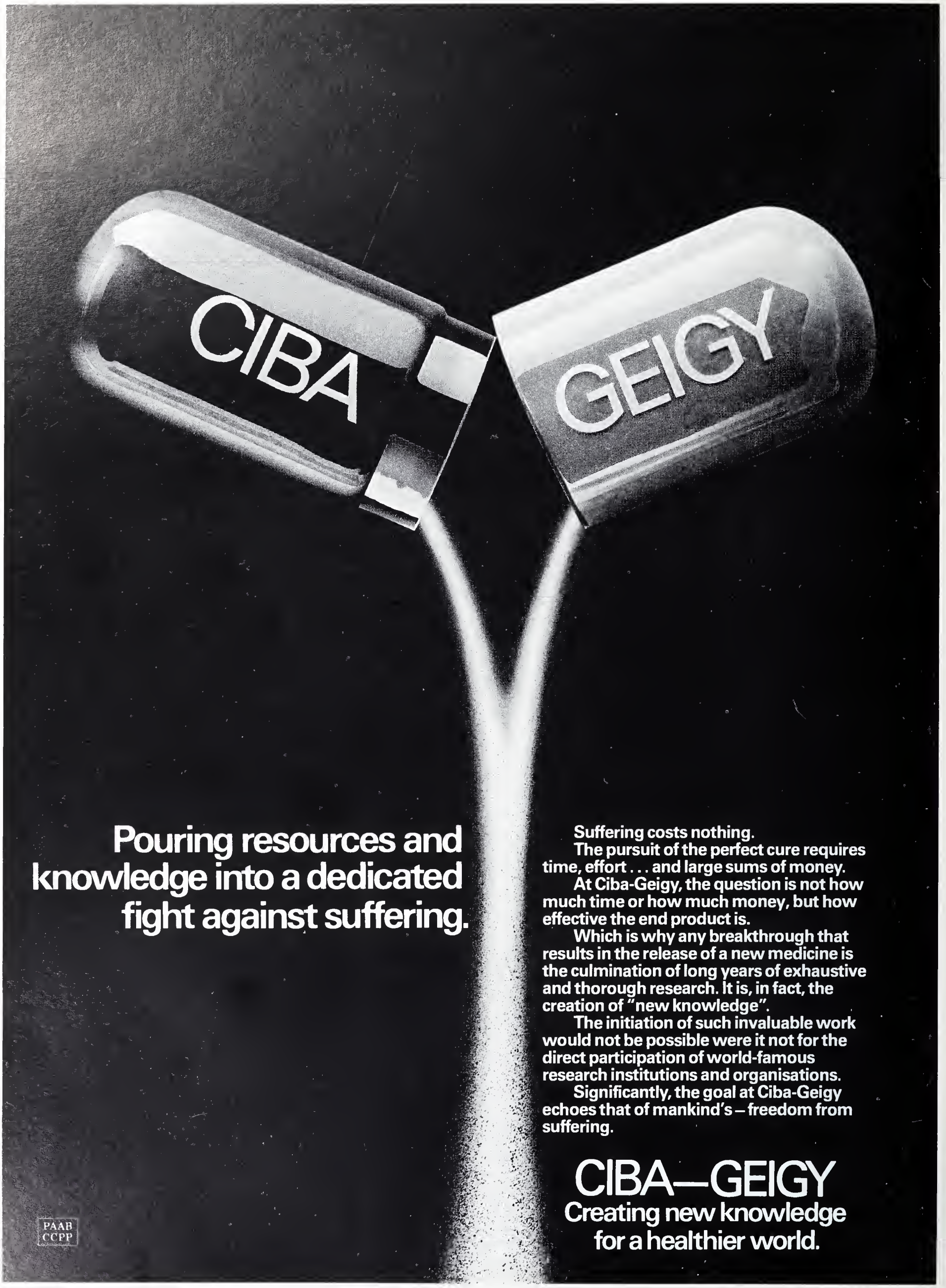

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